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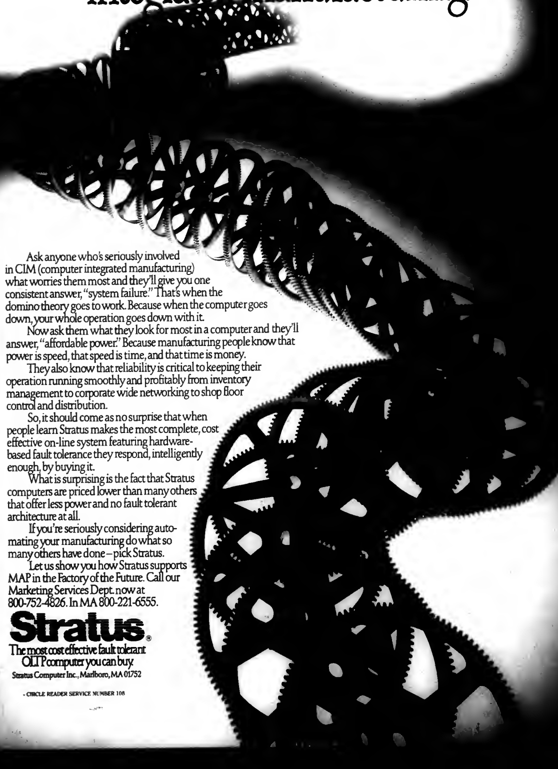

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• CIRCLE READER SERVICE NUMBER 108

CONTENTS

COMPUTERWORLD FOCUS

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FEATURES

13
MIS Gets Into Manufacturing
Ray L. Dicasali

MIS managers are in a strategic position to help facilitate the move toward automated manufacturing systems. Read how and why.

17
Users Move Toward MAP
Stan Kolodziej

Manufacturing Automation Protocol (MAP) is gaining acceptance. Where and how is it being implemented, what is IBM's role and what are users expectations?

21
On The Shop Floor With Micro MRP
Lee White

Here's a roundup of the latest in microcomputer-based MRP II. How does it stack up against its mainframe relatives?

34
Computer Vendors Reach For A New Market
Nina G. Lytton

Computer technology and vendors are becoming major influences in manufacturing. What are the most recent trends and what vendors are making the most impact?

39
A Global Standard At Black & Decker
Stan Kolodziej

How are companies handling the challenges of CIM implementation? Here's how one international corporation integrated computers and the manufacturing process.

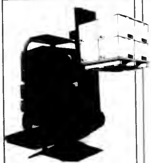
43
An Imperfect Union?
Lee White

Successful Automated Storage and Retrieval Systems call for close MIS and end-user involvement. Here are the benefits of ASRS and some tips on implementation.

13

17

34



43

FOCUS ON CAD/CAM

23
Microcomputers In The CAD/CAM Arena
Elizabeth J. Heichler

Personal computer CAD systems are proliferating. What are the causes and the effects of their expanding usage?

27
Integrating The New Mix
Joel Orr

As computers of all shapes and sizes appear in the manufacturing environment, MIS must cope with their integration.

31
Putting CAD/CAM Into Place
Peter A. Marks

It is increasingly important to understand the strategy of CAD/CAM planning and management. Here's some ideas for you.

DEPARTMENTS

Editorial 5
Insider 5
Q&A 6
Blue Beat 6
Manager's Corner 7
Issues and Answers 8
News 10
Products 47
Calendar 50

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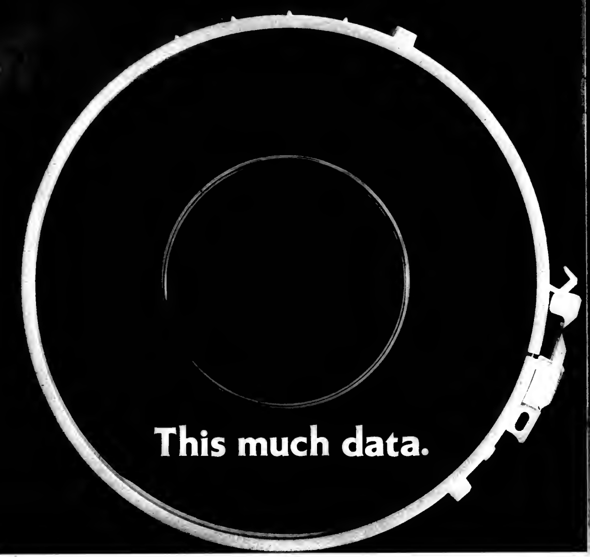

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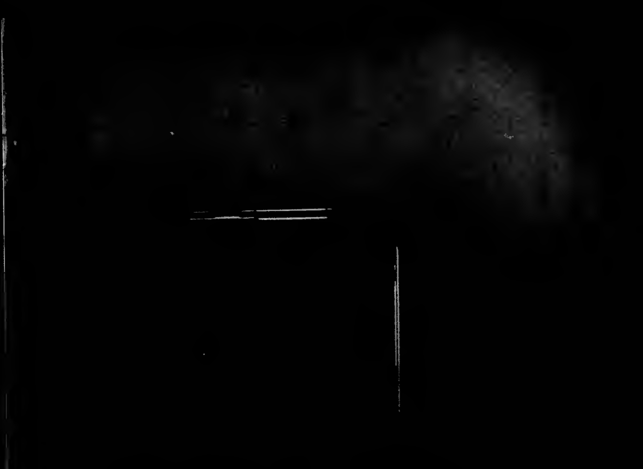

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CIRCLE READER SERVICE NUMBER 121

VIEWPOINT

EDITORIAL

A New Goliath

Pity the poor MIS manager. The average, hardworking MIS professional may think that the more things change, the more they stay the same. Another new Goliath — manufacturing — has appeared on the horizon for MIS to slay.

The need for these new manufacturing technologies is percolating from end-user departments on out. The demand from top management to increase productivity in the manufacturing arena is escalating, and computer technology is increasingly being looked to as the answer. Some systems are being put in place by individual departments and because these systems are most often computer driven, MIS eventually comes into the picture.

Sound familiar? Shades of microcomputing! Although manufacturing will not spawn the revolution in organizations that the micro has done, it is one more new set of technologies for the MIS manager to contend with. Few other professionals have gone through so many job transitions and evolutions as MIS has in the last few years. Instead of being caught by surprise as was the case with the micro, MIS, for the most part, is getting in on the factory floor.

What this will probably mean, however, is another battle over territory between MIS and engineering or the individual end-user department. Manufacturing honchos would like to keep MIS out, yet as more computer-related or computer-run technologies are introduced into the workplace, they no longer have any choice but to include MIS — that is if they want to meet their end goals of increasing productivity. And it is up to the individual MIS managers to take on the responsibility. It is up to MIS to integrate all the departmental data bases and provide a communication chain throughout the organization.

If MIS has any hesitation in deciding whether or not manufacturing is becoming part of their turf, they need only take a look at the vendors entering the field. IBM; Digital Equipment Corp.; Honeywell, Inc.; Sperry Corp.; and Data General Corp. are examples of mainstream computer vendors in hot pursuit of the manufacturing market. In fact, many of the companies that thought they had staked out safe niches are waking up to the fact that computer giants such as IBM and DEC are entering their marketplaces. The buzzwords are becoming applications as well — MAP is no longer just a technology. A growing number of organizations are starting up pilot projects.

MIS managers must face up to the fact that their jobs will be evolutionary for the foreseeable future. As technology changes, so will the scope and focus of their jobs. •

INSIDER

Robot Redux

By Timothy J. Caffrey

Along with the rest of high-tech, the robotics industry is picking up the pieces of 1985. With few exceptions, most vendors posted losses or slim gains for that fiscal year. Analysts who predicted unremitting growth are back at the drawing boards. One question: Why didn't robot shipments meet expectations in 1985? According to the Robotic Industries Association, close to 20,000 were shipped in 1985. The problem: Very few companies made much money doing it.

Industry analysts are quick to address the minor problem. International Data Corp. (IDC), Framingham, Mass., recently projected a lower yet still enviable compound annual industry growth rate of 26% through 1990 and identified three factors that contributed to the disappointments of the past year:

- Buyers decided to wait for customized robotic systems rather than buy off the shelf.
- The auto industry that accounted for close to 25% of total 1984 purchases failed to spend as heavily as expected in 1984.
- Buyers decided to figure out what was worth automating before doing so. Laying the foundation for factory automation apparently takes more time than expected.

The first of these factors reads like a lesson from the computer industry. General purpose processors are being fed into value-added and vertical market systems houses to be customized for specific markets. The generic system is going the way of the punch card. In the same way, robot system vendors are orienting themselves toward specific industry niches and applications. To date, the auto industry has been the most significant and sought after of these application niches. The problem lies in the fact that systems customization requires a significant commitment of time and resources. While this commitment is necessary, it requires a new approach to profitability that few vendors understood in 1985.

The 1985 watershed will play an important role in weaning robotics vendors from reliance on the auto industry. While auto manufacturers have been leading robot purchasers over the past several years, their consumption is leveling off. IDC estimates that in absolute terms the auto makers' purchases will grow slowly through 1990. The necessary reorientation to a broader mix of industrial applications is the badge of industry maturity. This will take time. Only when the entire manufacturing process is understood are robots brought in to automate that process.

Manufacturing Resource Planning (MRP II) systems allow managers to gain a better understanding of the manufacturing process. As a result, buyers are committing significant amounts of time and money to the understanding and implementation of MRP II systems. Strength in MRP II appears to be a necessary precursor for strong and sustainable sales of robotic systems.

1986 could well be a repeat of 1985. The ranks of vendors are likely to thin even further. Despite this less than glowing prospect, there are signs of a return to profitable progress. On the supply side, the flexibility and intelligence of robotic systems will continue to improve. Advances in vision systems, in particular, will allow robots to assume more demanding roles in the manufacturing process.

On the demand side, MRP II systems will allow buyers to tie robotics into factory operations in more efficient ways. More importantly, buyers are rethinking traditional cost-justification methods. Just as office systems are no longer justified solely on direct labor savings but on improved qualitative outputs, robots are being viewed as a means of maintaining and improving competitive position. Slow but steady, robots are back.

Caffrey is director, strategies for micros and office systems, for International Data Corp. in Framingham, Mass.

dB
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Q&A

Automation's Impact On The Work Force

Harley Shaiken is associate professor in the Department of Communications, the University of California at San Diego and a former research associate in the Program in Science, Technology and Society at MIT in Cambridge, Mass. His book Work Transformed: Automation and Labor in the Computer Age *was published by Holt, Rinehart and Winston last year.*

Do you think U.S. industry has reached the stage where it has to introduce automated manufacturing systems to stay internationally competitive?

I don't think the real issue is introducing automation per se. I think the real question is the kinds of systems that will be introduced, how effectively they're going to perform in practice and how workers, managers and communities are all affected by the changes.

For example, we assume that the computerized, automated factory is an off-the-shelf item that works perfectly as soon as you plug it in. In fact, the opposite takes place. Since the early 1950s, automated equipment, predating the computerization of the factory, has been plagued by severe reliability problems and downtime. In automobile engine production, for example, you have downtime that often approaches 40% to 50% of the equipment capacity. If that's the case, then rather than more automation, the real issue may be how effectively automation is used and what the determinants of that are.

Can we really be sure how effectively automation is being used? Are there parameters for managers to judge by?

Harley Shaiken

Many managers make a mistake by divorcing technical issues from social ones. They'll sit down and say they need robots, computerized machine tools, computer-aided design, and once they have that state-of-the-art technology they'll be far less dependent on workers for quality and productivity.

Not so. It's true that direct labor is frequently automated very rapidly, but the entire system depends to an unprecedented degree on maintenance and repair and other forms of indirect labor for production to function properly. And in design, the uniquely human qualities of creativity, experience and skill are absolutely essential. If the manufacturer has in mind computerization as an alternative to human input rather than as a key supplement, the results can often be very complex systems that in practice don't particularly work well.

Does this whole issue involve white collar as well as blue collar workers?

Absolutely. It's an important issue, and the key question that spans both white collar and blue collar work is the role of the individual in the computerized process and the extent to which the company, whether in engineering, the office or the shop floor, perceives computerization as a human substitute in very many instances. There could be problems.

I think in part the vendors of this equipment have failed, but the real, ultimate responsibility is in the user industry, those companies that are buying and implementing the manufacturing systems. But many vendors in this area often give the impression that little infrastructure or preparation is needed before introducing the systems. There has been a whole history in this area of overselling the capabilities of new systems and often those user companies that buy them wind up very disappointed. All of this is said in the context of computer-based automation as a very powerful and effective tool, but it doesn't happen automatically.

Where do MIS managers fit into all of this?

One of the real impacts of the computerization of work is that very different functions are suddenly tied together. The kind of data processing that MIS managers were involved in becomes much more related to other computerized events in a company. One of the strong impacts that we see today is the broader view required about what's taking place in a firm.

Is the Manufacturing Automation Protocol (MAP) from General Motors Corp. going to have a big impact on manufacturing?

Yes. It's going to set a pattern for industries outside the automobile area. What MAP indicates is the real challenge of tying manufacturing systems together. That MAP does it so effectively results in some qualitative new ways of integrating factory production.

With all the attention that Japanese modes of production have been getting, will there be more of a Japanese orientation in the U.S.?

I think that remains to be seen. The Japanese experience is interpreted differently by almost everyone that looks at it. What becomes misleading is pulling specific aspects out of context. There are things, however, that can be learned from the Japanese in terms of factory production. They tend toward simpler approaches which they use more effectively. But rather than being one key to unlock the Japanese success, there are really a thousand keys, each of which looks at a small step, but together turn out to be a very effective approach to manufacturing.

— Stan Kolodziej

BLUE BEAT

Manufacturing — The Promise Of Integration

By Dale Kutnick

While manufacturing and factory automation systems represent a multibillion dollar market during the next decade, there are many key issues yet to be resolved if this sector is to avoid many of the pitfalls that have hampered the data processing industry in general and the office automation market in particular. While there are some similarities between the development of the office and factory markets, there are critical distinctions in their development and implementations. Factory events are often timing-critical (such as spray painting one section of a passing car) and take place in a hostile environment (electromagnetic interference and high voltage). Therefore, high-level, synchronous integration between systems, machines and processes is a necessity if a factory is to become truly automated, with minimal human intervention.

Yet the battle lines for incompatibility have already been drawn as individual suppliers religiously stake out their turf in specific factory automation market niches. Traditional computer vendors like IBM, Digital Equipment Corp. and Hewlett-Packard Co. are competing with factory sensor, process and programmable controller suppliers for hegemony on the factory floor. Robot and vision system vendors are blindly charging forward, bathing each other in red ink as the 30%-plus market growth proves insufficient to support their bottom lines. While the computer-aided design and computer-aided engineering (CAD/CAE) workstation and software business is still flourishing, its use brings little to the actual manufacturing side of the equation (the acronym CAD/CAM doesn't reflect reality).

Moreover, these disparate camps are driving a wedge between users — manufacturing plant managers and the MIS directors (with the latter acquisitively looking to extend their turf to yet another arena). Perhaps it is inevitable that MIS will eventually gain the upper hand because traditional data processing systems (minis, mainframes and personal computers) already manage corporate-, plant- and supervisory-level planning and control. The promise is that they will be better able to integrate the islands of automation and manual tasks that already exist in most factories.

Many people (General Motors Corp. and others) have hailed the user-driven Manufacturing Automation Protocol (MAP) factory local-area network standard as if it will be the messiah for solving vendor incompatibility and a panacea for building the mythical factory of the future. But this local-area network market is in its infancy — $15 million in 1985, $35 to $40 million in 1986 — perhaps $350 to $400 million by the decades' end. While there is no doubt that future factories will be built around a sophisticated communications network — connecting CAD/CAE, computers, sensors, controllers, robots, conveyors and so on into a single system — the key unifying elements will be:

- A more unified approach to factory planning and design, including organizational issues.
- High-level interprocess software (especially between design and manufacturing).
- Integrated data base management systems (between business, electronic data processing, design, manufacturing resource planning (MRP II) and plant floor control systems).
- Network management and control.

Communication standards are certainly a critical element and a good starting point in unifying some of the diverse factory processing elements, but such connectivity will only solve the simplest problems. It is the process that must be integrated, and this will require sophisticated, complex software that is not yet even extant within a single manufacturer's own product line. Consider for a moment IBM's inability to integrate fully its COPICS manufacturing and control software package with its CADAM design software or with its IMS data base or GDDM business graphics. The task is monumental. Yet consultants speak of factory automation as if it will blossom overnight.

Compounding this problem, of course, is that other vendors' systems must also be integrated and that specific user problems (applications) must still be addressed with piecemeal solutions while the more global issues are resolved. This will again create (as it did in the business data processing industry) layer upon layer of incompatible software — chasing an elusive goal that always seems to be just beyond reach.

Without question, solving the factory automation puzzle will require more vendor and user cooperation/compatibility than has taken place in the history of computing. Certainly, new tools in artificial intelligence and expert systems will aid in this effort, but it will be well into the 1990s before significant results can be accomplished. In the interim, joint ventures and alliances between users and suppliers — while encouraging an innovative, entrepreneurial climate — will be the critical success factors that will forge the future factory.

Kutnick is an independent consultant based in Wayland, Mass., specializing in strategic planning for IBM users and competitors. He was formerly executive director of The Yankee Group.

MANAGER'S CORNER

Avoiding The "Ready, Fire, Aim" Syndrome

By Jim Young

When I say that a strategic Information Resource Management (IRM) plan is important in today's manufacturing environment, it is not because I am some strategic planning bigot. I am not one who thinks of an IRM plan as an obligatory component to every data processing department. I do feel, however, that there are certain specific situations where such a plan is essential. For example, in situations of high growth or significant change, a long-range road map will prevent the "ready, fire, aim" syndrome. If data processing elements are among your company's critical success factors, a strategic plan will keep crucial data processing activities aligned with company programs and provide a forum for top management participation. Though these situations may not apply to all data processing shops, there is one other condition in most manufacturing firms that requires a companywide strategic IRM plan. That is integration.

It is not an exaggeration to say that manufacturing is under tremendous pressure to streamline and become more efficient. Correctly or incorrectly, technology is being looked to as the remedy. In every area, solutions are being applied like bandages to an accident victim.

Whether this outburst of attention will pay off in lower cost, more flexibility and higher quality remains to be seen. However, this technological feeding frenzy has one serious problem. It permits disjointed inconsistent solutions. If you are one of those who thinks that coordinated solutions are unnecessary or that the various systems have nothing in common, consider the following:

- Data base: Some data that computer-aided design/manufacturing (CAD/CAM) needs is also used in MRP II and shop floor control. The timing of data changes needs to be coordinated across systems. Unfortunately, many systems are being designed oblivious of future data duplication.
- Technology: Because networks will undoubtedly be the glue that unites various specialized solutions, systems should be selected with interconnection in mind. Today's selections may be doomed to extinction because of incompatibility.
- People: With technical responsibility being spread across the organization, better definition of responsibilities, sharing of skills and alignment of career patterns will be needed.
- Procedures: Data controls will have to be defined across functions. Management processes like production planning, forecasting and so on will have to change just as will the manufacturing process itself.

Instead of trying to implement some highly complex solution immediately, it is better to continue to attack today's productivity problem piece by piece. This focuses on the critical problems, simplifies the short-term solution and gives quicker results. Besides, the technology for a fully integrated system is still in its infancy. Therefore, let today's solutions be the foundation on which to build tomorrow's more elaborate structures. It will be essential to use an IRM strategic plan as a blueprint to manage the integration of manufacturing solutions if we are to reap the promised benefits from technology.

Young is a principal and the director of consulting for Arthur Young & Co., Worcester, Mass. He has worked in the industry for 15 years.

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5. What about specific production economies?
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6. Do other experts support your claims?
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- 60% increases in indirect labor productivity
- 50% reductions in scrap, rework, warranty costs
- 80% reductions in inventory
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CIRCLE READER SERVICE NUMBER 120

ISSUES & ANSWERS

Manufacturing Technologies: Putting It All Together

By Robert D. Gilges

The convergence of modern management techniques with advancements in technology have created many potential solutions that manufacturers may use to solve a broad range of business problems. Instead of relying on just one technique, the best solution may, in fact, be to integrate several currently existing technologies.

The first technique is computer-integrated manufacturing (CIM). This is the application and integration of computer-based technology and information with the goal of improving quality, reducing costs, minimizing product development cycle time and increasing flexibility. Major components of CIM technology are as follows:

- **Resource Planning Systems:** These include the computers and programs that perform the planning and control; the utilization of manufacturing capacities in terms of equipment, facility labor and capital; and the control over the raw materials, work-in-process and finished goods. Current resource planning systems also provide capabilities for monitoring the execution of plans for shop-floor priorities and the purchasing of the raw materials.
- **Computer-Aided Design, Manufacturing and Engineering (CAD/CAM/CAE):** This technology uses the computer for designing both the products and their manufacturing process. It is also used in the engineering of the product. The capabilities of these systems include two-dimensional and three-dimensional drawings, defining manufacturing processes, creating software to drive computer numerical control (CNC) machine tools and applying engineering analysis to product designs.
- **Work Center Controllers and CNC Devices:** This computer-based technology controls the operation of various machine tools, or cells, of machines on the factory floor. There are various levels of operations that take place on the factory floor. The factory computer that can theoretically control and monitor various work center controllers and other lower-level aspects of computer control is of utmost importance.

Following this comes the work center, or cell controller, which coordinates and controls groups of machines that reside within a cell. These machines might, in turn, have computer-controlled devices. Other techoologies that would be controlled by factory computers include materials handling systems, flexible manufacturing systems, robots and inspection devices.

- **Shop-Floor Data Collection:** This provides for the timely and accurate feedback of actual operations to planning, control and quality systems. Historically, this area has been an Achilles' heel for computer-based control systems such as manufacturing resource planning (MRP II). The technology captures data dealing with labor; material usage and movement; and inventory and work-in-process location. In addition, valuable information can be collected in a cost-effective manner for inspection results, tolerances and machine utilization.
- **Office Information Systems (OIS):** This is a critical and often neglected component of CIM technology. OIS accesses information maintained by other CIM components in order to assist in management activities. The technology includes data base management capabilities (often relational), data manipulation software (fourth-generation high-level languages), query/report writers, modeling capabilities, text management, filing and graphics capabilities and, recently, expert systems.

OIS objectives include the supplying of support for decision makers in order to increase productivity and, more importantly, provide assistance in the decision-making process. Goals of OIS include identifying problems, collecting data, analyzing alternatives, selecting a course of action and directing its implementation.

- **Communication Networks:** These tie together the areas of communication and provide the vehicle for sharing information. Based on the definition of CIM, communication networks are an important component in the integration of information.

Now that we have an overview of CIM technology, let's define MRP II. First, MRP II is not software, but a planning concept that can help determine those manufacturing resources that are required to support a strategic business plan. In the first part of the MRP II cycle, business plans must be translated into sales plans, indicating the product family and the sales goals, often in dollars instead of units. From this plan, manufacturing resources are determined. These include personnel, facilities (capacities), equipment, materials and capital requirements.

The key benefit to be derived from this approach is MRP II, which can now be synchronized to support the business plan. MRP II is a recurring process, an ongoing attempt to match resources with demand in order to attain business goals. Planning must flow from the business

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plan to the sales plan to production plans, always checking and adjusting to ensure the plans can be achieved and they match the business goals.

Most of the MRP II systems used today focus on master scheduling activities. Beginning with the master scheduling process, the system aids the planner in establishing a realistic manufacturing schedule by coping with the following demands: balancing the forecasted and shipping budgets with the resources and weighing plant capacity, material availability, vendor capacity, lead time and capital. The system compares demand requirements with available resources and identifies potential capacity problems that must then be adjusted.

After the MRP II schedule is finalized, capacity requirements must be developed. The capacity requirement planning module takes into account the output needed to maintain current production levels. It also controls planned production activities. The requirements are time phased, to identify overcapacity situations by day, week or month. Again, this analysis must be analyzed by the planner; either the MRP II schedule will be adjusted or capacity will be increased.

> ”
>
> *Instead of relying on just one technique, the best solution may be to integrate several currently existing technologies.*

Let's now look at Just-in-Time manufacturing. Unlike CIM and MRP II that involve a high degree of automaton, Just In Time is a manufacturing philosophy that dictates a disciplined approach toward improving overall productivity and quality through the respectful use of human labor and the elimination of waste. Just In Time is striving to develop a continuous manufacturing process with the goals of zero inventory, zero defects, zero setup time and lot sizes of 1.

The importance in automation is that you do not automate waste. In the ultimate Just-in-Time system, work in process consists of one piece in each machine io the product-oriented production line. Each piece is moved from machine to machine one at a time, either manually or automatically, depending upon its nature. This batch-of-one system completely eliminates work-in-process inventory between processes, storage and handling and waiting time and does not operate if any process is defective.

Just In Time is striving for continuous improvement, not just a program. It includes items such as reducing inventory, lowering setup time, arranging machines by product instead of function, improving quality, committing employees to the program, containerization, stabilizing the production schedule and creating new supplier relationships. While Just In Time cannot be defined specifically as any one of these, the techniques are used to make manufacturing lead time approach zero and make the defects approach zero, with the goal of manufacturing only the amount required as required.

Some of the Just-in-Time techniques are quite different from current manufacturing practices used by many companies. These practices include:

- Single sourcing, which is forming a team with a vendor that includes schedule stabilization, commitment to use capacity, quality, elimination of receiving inspection on parts from vendors and even elimination of parts engineering.
- The dedication of group machines in cells to certain products that require multidisciplinary operator training and undercapacity scheduling. Cells can reduce work-in-process queue time and reduce travel of the product, which can result in drastic work-in-process reductions (up to 50% in some cases), reduce complicated priority determination, lessen work-in-process on the floor and provide immediate feedback on quality problems and sources of the problems. One study has shown that of the time a job is in process, the job is working in queues or being moved 90% of that time.
- Short production runs greatly reduce work-in-process and increase flexibility, thereby meeting user demands without the keeping of large inventories. Utilization is not the name of the game — it is "don't make something if you don't need it."
- The component cycle shouldn't be shorter than the assembly or downline process required for the component. This eliminates work-in-process buildup and space requirements.
- Safety stock only hides problems and should not be allowed. All problems discovered should be solved by an individual or by the group.

As manufacturers, we are competing in an international arena where there are significant factors working against us. A strong dollar, barriers to entering some foreign markets, higher wages and a management vs. labor adversarial relationship have hurt U.S. manufacturing. To compete effectively, even survive, we must take advantage of the benefits available through CIM, Just In Time and MRP II. And for most us, we can't wait and see; we must act.

Gilges is partner in charge, information systems services consulting, at Peat Marwick, Mitchell & Co. in New York City. This article was prepared in conjunction with Peat, Marwick's manufacturing industry practice group, Chicago, Ill.

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CIRCLE READER SERVICE NUMBER 114

Update: A Look At Recent Manufacturing News

Computer-integrated manufacturing (CIM) is a fast developing area that will increasingly impact MIS managers in terms of responsibility, planning, product purchases and integrating technologies. A number of developments have occurred recently of concern to MIS managers.

A big boost for General Motors Corp.'s Manufacturing Automation Protocol (MAP) was provided at the annual Autofact Conference and Exposition held in Detroit in November 1985. The show opened with 21 manufacturers participating in a MAP demonstration coordinated by GM and the Boeing Co., the latter demonstrating its Technical and Office Protocol (TOP) standard designed for office communications.

The conference proved to be a watershed for MAP with many vendors announcing MAP-related products and users describing MAP pilot projects. Attendance at the show was up significantly over 1984. "This is not surprising, considering there's more interest in CIM and communications within the factory and only about 15% of the devices in most factories talk to one another," an industry analyst explained. "MAP is perceived as the vehicle to tie these devices together. The fact that MIS and communications people were conspicuous at the show this year means MAP is becoming viewed as a big part of CIM."

Autofact '85 was also used to announce the current MAP Release 2.1 specification and the corollary IEEE 802.4 protocol as the backbone network of MAP. Among the MAP products announced by vendors were the Mapserver 10M bit/sec MAP interface from Concord Data Systems, Inc. and two IBM programs for the IBM Series/1 computer with support for MAP (these programs are being installed by IBM in three separate IBM MAP pilot projects).

"What Autofact '85 established," said Adam Zais, director of Computer-Integrated Manufacturing Services at International Data Corp. (IDC), Framingham, Mass., "is that it has become the premier show for CIM. It has also become a solution show as opposed to a product show. There were more vendors acknowledging they did not bave the complete CIM package and had to work with other vendors to provide the pieces."

MAP received a second boost at the January 1986 MAP Users Group meeting in Toronto. The show was highlighted by the many vendors jumping onto the MAP product wagon and the increasing number of users who announced MAP pilot projects. Significant vendor announcements were led by IBM, which declared a joint MAP product development agreement with Industrial Networking, Inc., a Santa Clara, Calif., MAP product manufacturer. IBM's announcement did not hint at the possible products coming from the union, but that IBM declared its MAP product commitment was significant enough for many industry analysts to regard the announcement as a MAP blessing from IBM. Other important MAP announcements came from Digital Equipment Corp., which declared a MAP interface between Control Data Systems' Token/Net network and DEC's Microvax computer, while Motorola, Inc., Allen-Bradley Co., Honeywell, Inc., Fairchild Data Corp. and Stratus Computer, Inc. announced similar MAP products.

The Toronto meeting also saw details of MAP pilot projects from Eastman Kodak Co., John Deere Harvester Works, Whirlpool Corp., Kaiser Aluminum and Chemical Corp., IBM, Honeywell as well as numerous projects within GM.

Another hot area is the computer-aided design/manufacturing (CAD/CAM) technology, especially in CAD workstations and personal computer-based CAD systems. "1985 saw the evolution and legitimization of personal computer-based CAD systems," according to Vicki Brown, senior analyst in Computer-Integrated Manufacturing Services at IDC. "It was also the year war was declared in the CAD workstation market. Vendors competed to produce better, cheaper CAD workstations." Figure 1 shows annual workstation shipments including CAD, CAM and computer-aided engineering (CAE).

1985 Autofact Conference and Exposition in Detroit

January 1986 saw two giants, IBM and DEC, go head to head in the workstation wars, with DEC introducing its Unix-based Vaxstation II/GPX workstation while IBM unveiled a line of 32-bit workstations called the RT PC line featuring Reduced Instruction Set Architecture (RISC), aggressively priced in the $11,000 to $19,000 range. Sun Microsystems, Inc. sent a volley from California by introducing low-end technical workstations that are 32-bit machines and offer 4M bytes of main memory priced from $7,000 to $13,000. Apollo Computer, Inc., smarting from a poor financial performance during 1985, has responded with its own low cost, 32-bit Series 3000 workstations and two 3D workstations with which it hopes to stall DEC and IBM from making major inroads into the technical workstation market.

"What's clear," IDC's Adam Zais said, "is that the technical workstation market is no longer a safe niche market. IBM has opened it up."

Other important developments occurred in the area of industrial standards. The National Bureau of Standards (NBS) completed a prototype software program that links incompatible hardware and software systems to perform CAD and automatic realtime code generation for the machine tool industry. Developed at NBS' Automated Manufacturing Research Facility, the prototype is aimed at production shops where numerically controlled metal-cutting machines produce small parts used in other machines.

Sun enjoyed success in getting its proposed Network File System (NFS) network protocol adopted by several leading computer manufacturers including DEC, Gould, Inc. and Data General Corp. NFS is aimed at the seventh (application layer) of the International Standards Organization (ISO) communication protocol layer. MAP is based on the same ISO model, but the seventh layer in MAP is still undefined. NFS, with its industry support, could become the vehicle by which graphics are communicated over MAP networks.

There was also a significant surge of interest in the Graphical Kernel System (GKS) standard for two-dimensional graphics and many graphics hardware and software manufacturers included compatibilty with GKS in their new products.

Two other announcements in 1985 that might have an impact on manufacturing should be noted. DEC's Microvax II packs the punch of its 11/780 minicomputer at a fraction of the cost. As a driver for DEC's industrial networks and manufacturing systems, the Microvax II is going to be a good wedge with which DEC should increase its already extensive industrial presence.

Last but not least was IBM's long awaited Token-Ring network. Though as yet only a PC-based network and woefully incomplete in the opinion of many industry analysts, the network still offers open architecture and the ability for vendors to provide many components to expand the network.

How important will the network be in the manufacturing area? "That's hard to tell," IDC's Zais said. "But it is from IBM. That's important enough."

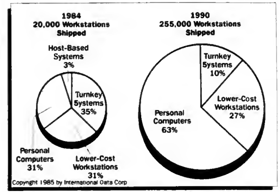

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Figure 1. Annual U.S. Shipments Of Workstations By U.S. Suppliers

Major Players Support MAP,TOP

Computer-integrated manufacturing (CIM) has been recognized for some time as the key that manufacturers need to regain leadership in the flagging U.S. manufacturing market. Interest in CIM has been spurred by some recent developments including General Motors Corp. Manufacturing Automation Protocol (MAP) and Boeing Computer Services Corp. Technical Office Protocol (TOP).

Like the phrase "money attracts money," companies like GM and Boeing are attracting big players into their protocol arena. Data General Corp. in Westboro, Mass., is on record as committed to supporting MAP and TOP. "In terms of TOP, we already support Ethernet across our product line. All we need to do is add some of the high-level protocols on top of Ethernet and X.400 and we will be compatible with the TOP specification," Joe Forgione, DG's communications product marketing manager, said.

Digital Equipment Corp. has also come out in favor of TOP and MAP. "DEC supports MAP activity as a practical demonstration of the strengths of multiple vendor cooperation," John Ferriero, CIM Networks marketing manager at DEC, said. DEC demonstrated TOP architecture at Autofact this past November when it showed Open Systems Architecture (OSI) running on Ethernet and also presented a demonstration of MAP and TOP protocols in its new technology area at Decworld in late February.

It has been reported that IBM's strategy is to work from the proprietary subnetworks via cabling up to Systems Network Architecture. Unsubstantiated rumors say IBM will also support TOP because it participated in a recent TOP users meeting.

Apollo Offers Workstation

Apollo Computer, Inc., the Chelmsford, Mass., technical and engineering workstation company, is one of the newest students to learn a tough lesson: When a market burgeons and looks financially lucrative, other entrepreneurial geniuses decide to get in on the action. In this case, the Mountain View, Calif-based Sun Microsystems, Inc. introduced low-priced Unix-based technical workstations that nibbled away at Apollo's slice of the pie. IBM and Digital Equipment Corp. announced technical workstations of their own: the IBM PC RT Reduced Instruction Set Computer and the DEC Vaxstation II engineering system, both of which are Unix-based.

But Apollo decided not to roll over and play dead, even after a disastrous 1985 that saw 300 employees laid off, a stock dip to $13 from a 52-week high of $30 and the departure of its founder and chairman, William Poduska. Under the leadership of Thomas A. Vanderslice, named Apollo's president in late 1984, the company has taken some steps to regain the title of top dog in the technical and engineering workstation arena.

On February 19, Apollo made a number of announcements that should keep the competition hopping. The Domain Series 3000 Personal Workstations, available in high-resolution color or monochrome models, combines the attributes of personal computers with the functionality, advanced graphics and 32-bit computing power necessary to run engineering and scientific applications. In addition, the workstations utilize the open architecture of an IBM Personal Computer AT-compatible bus with the 32-bit Motorola, Inc. MC68020 processor and MC68881 floating-point coprocessor that will allow users to integrate into the Domain System a wide variety of integrated circuit boards and other peripheral devices. The Series 3000 monochrome model will be available in May with a starting price of under $10,000 and will include 4-bit planes for simultaneous display of 16 colors from a palette of 4096 colors, up to 24 concurrent processes with 64M bytes virtual address space/process, 2M bytes of memory, an optional 72M-byte Winchester disk drive, high-density 1.2M-byte 5¼-in. floppy disk drive, 60M-byte ¼-in. cartridge tape drive and Domain/IX (Unix System V and Berkeley Unix 4.2) and Aegis software licenses. The color version of the Series 3000 is available immediately for $14,900 and has all the features of the monochrome unit plus a 15-in., 60-Hz noninterlaced, nonglare color monitor with 1024 by 800 resolution.

Another announcement made by Apollo on February 19 was its DSP9000, a parallel processor and compute server with up to 94 million floating point operations/sec (Mflops) and 35 million instructions/sec (MIPS).

Apollo has great hopes these announcements will give the company the impetus it needs to regain its lead. The DSP9000 is aimed directly at the DEC market. "Even the smallest DSP9000 configuration delivers about the same performance of the largest DEC machine, the VAX 8800, for less than half the price [$195,750]," Eric Hillman, Apollo's server marketing group manager, said.

Richard J. Matlack, president of Infocorp, a market research firm in Cupertino, Calif., was impressed with Apollo's stated direction, terming the product announcements "pretty heady stuff." He said the problem Apollo has had is that "the world is going Unix and they had a proprietary network system. Unix compatibility across Domain really takes away that objection." Of importance, according to Matlack, is the new pricing. "[Apollo] had not had the low end of the market covered. By moving down into the $10,000 range [for the Domain monochrome workstation], they're in the same area where Sun is, actually. What Apollo is doing, clearly, is filling out that end of their product line. That's commendable and what they have to do to stay in a leadership position," Matlack concluded.

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CIRCLE READER SERVICE NUMBER 115

What's In Store For CAD/CAM At Computervision

For years, Computervision Corp. (CV) was the Cinderella of the computer-aided design/manufacturing (CAD/CAM) industry. A pioneer in the field since the early 1970s, the Bedford, Mass., company began with its own proprietary CAD/CAM software running on the Data General Corp. Nova computer. They moved on to proprietary hardware and operating system software in order to avoid having to rewrite code every time DG made hardware and operating system software changes. In May 1984, CV introduced its CVS 3000, a Sun Microsystems, Inc.-based workstation running under a Unix operating system. At that time, CV was the sales leader, earning $41 million on sales of $556 million.

But CV did not heed the fairy godmother of the CAD/CAM market and stayed too long at the ball. While the market increased 24% to $3.5 billion in 1985, CV lost $59 million through the third quarter 1985 on revenues of $324 million, dropping its market share from 20% to 12% in one year.

What caused such a precipitous decline? A spokesman from CV said the situation in 1985 became more and more critical because the company's large, multimoduled proprietary library of software that covered the range from front-end conceptual analysis through computer-aided inspection did not run on the new workstation without special interfaces, emulations and an enhanced graphics board. Just when the market was screaming compatibility across product lines, CV was bogged down in a proprietary morass.

CV expects to see a big turnaround in 1986. Within the next six months the company will introduce its software on a Unix platform on the new workstation. The ported software is in beta test at 16 sites worldwide and according to the company preliminary reports from the sites are very positive. However, the company spokesman stressed that CV will not announce the product until it is ready. "Our reputation has been scarred. Because of that, we won't be introducing [the software] until it is perfect," he said. While the spokesman would not commit to a time frame, he said the announcement will take place in 1986 and "[the software] will be available to customers even before the announcement."

There is little question CV is in a make or break situation. "The future of CV has to do with being able to move its CADDS 4X software off the CVS 4000 platform into a Unix workstation environment. The success of CV hinges on how well they can deliver that product," said David Burdick, associate director of CAD/CAM Industry Service at Dataquest, Inc., a market research firm in San Jose, Calif.

Just In Time Gets Into Gear

Along with the terms computer-integrated manufacturing and Manufacturing Automation Protocol can be added Just In Time, a concept gaining more attention in U.S. manufacturing circles.

Just In Time can be a bit confusing. It's a philosophy, not a technical system, according to Adam Zais, director of Computer-Integrated Manufacturing Services at International Data Corp., Framingham, Mass. "Just In Time is based on the idea of continually trying to improve the manufacturing facilities through improved workplace conditions, improved distribution and improved assembly. Complicating the matter is that there is no one Just-in-Time prescription. Each situation is different." One industry analyst, however, described the Just-in-Time manufacturing technique as just enough inventory for the job, just in time.

The fact that Just In Time can be so abstract is not preventing it from becoming more popular in the U.S. Zais termed 1985 as the year of general awareness of Just In Time, and several industry organizations have been promoting Just In Time as a tool to reach a goal of zero inventory gradually.

Xerox Corp. is heavily involved in trying to bring the Just-in-Time philosophy to market. The company's Computer Services division introduced a Just-in-Time system in 1985, has been successful in installing the system in Europe and is now actively promoting it in the U.S.

The Xerox Just-in-Time system is termed the Business Management System and is meant to achieve the following benefits: reduction in work-in-process inventories; decreased material flowtime from vendor delivery to shipment of finished goods; elimination of work orders; increased accuracy of work-in-process accounting balances and decreased paperwork and administrative costs.,

Within the manufacturing community, John Proud, manager of Just-in-Time Manufacturing at Xerox Computer Services, explained it's generally agreed production methods must be adopted to pull work-in-process along the assembly line rather than push it along, as has been standard. Proud said this is critical to maintaining productivity and quality edges over foreign manufacturers who have already successfully employed Just In Time. "The key to the whole system," Proud added, "is to balance supply and demand within constraints placed on it."

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   - 70. Mining/Construction/Petroleum/ Refining/Agriculture
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3317-0536

MIS Gets Into Manufacturing

• BY • RAY • L. • DICASALI •

At the same time MIS professionals have been advancing state-of-the-art data processing, they have been developing new, more efficient methods of managing production.

Over the past 15 years, MIS personnel have worked diligently — and successfully — to build and implement sophisticated systems for consolidating data on manufacturing resources and requirements within the factory walls. Some of the earliest factory automation was software for managing inventory, capacity and activity on the shop floor. The first data base was IBM's disk bill-of-material processor (DBOMP) system for manufacturers. Because of these efforts, production and operations managers now have at their disposal powerful tools for planning and controlling almost every aspect of production.

But what we haven't done until recently is shift our focus to the end of the manufacturing cycle in order to build sophisticated systems to manage the market demand for the product. Separate systems have evolved for managing order entry, forecast, finished goods and distribution requirements planning. But they weren't effectively tied together. We learned years ago that we cannot accurately determine the material requirements for production without knowing the specific production schedule. Similarly, we have discovered that due to increased market pressures we cannot effectively plan a production schedule that will satisfy the market needs without accounting for all the components of real demand.

One of data processing's chief functions is to maintain data in useful formats. Data in its simplest form has value to individual functional departments. But in order for data to have strategic value to the company, very often it must be consolidated with data from other systems. A limited number of MIS managers and a few software companies have come to appreciate this and its impact on managing true market demand. Some have made considerable progress in this area. What they have discovered is that the potential impact of this integration is equal to if not greater than the impact of the evolution from basic materials requirements planning (MRP) to manufacturing resource planning (MRP II) systems.

MIS managers are in the unique position to help engineer this next advancement in information systems for manufacturers. Data processing personnel who understand and can think strategically about business issues are extremely well-positioned to have a profound impact on the business — they are the only ones outside of top management whose view of the business extends beyond the conscribed limits of a functional area. Conversely, they must play a major role because managers of other functional departments are so closely focused on their own areas that they cannot see the bridges that unify the entire manufacturing operation.

MIS managers who can think strategically about the business know where the information that has strategic value resides. It will require that they think not in terms of a single corporate data base, but rather in terms of building a corporate information base. If the promise of computer-driven, computer-integrated manufacturing (CIM) is to be realized, it must be more than robots talking to robots. It must be production talking to marketing. MIS managers are in position to help make this happen.

The true goal of CIM, given increasing competitive pressures in the world market, must be to produce what the market wants when it wants it. The management of the crucial factors involved in this is called demand management. Demand management looks at the market a manufacturer sells to in terms of the demands it makes on manufacturing resources and products. Effective demand management addresses the real issue of just in time — just in whose time? The answer isn't just in time for a machining or assembly center on the shop floor. Ultimately, it must be just in the customer's time, whether that customer is a distribution warehouse, center or the final customer.

The individual functions of demand management already occur in manufacturing and distribution operations. These include order entry, promising and management; sales forecasting and planning; physical distribution planning and replenishment; and scheduling for manufacturing production. Though these functions already exist, the responsibility for them is typically widely delegated throughout the company. Demand management is the integration of these separate functions through the sharing and consolidation of data from one area to the next.

Let's review the detailed flow of information in the integrated demand management environment. First we will consider the information flow for make-to-stock operations and then outline the various points of difference for assemble-to-order manufacturing.

Typically, make-to-stock (MTS) manufacturers produce consumer items where there is a high volume of customer orders and a large product mix. Products include the manufacture of auto parts, small appliances, apparel, food processing, toys, hardware and pharmaceuticals among others. If there is no stock available, it very often means no sale. The critical management issue, therefore, is coordinating manufacturing and distribution center replenishment schedules to satisfy demand without overbuilding inventory.

When an order is received and processed in an integrated demand management environment, the order entry clerk can promise an order delivery from on hand or in transit inventory in the distribution network, from planned but as yet unauthorized inventory replenishment scheduled by the distribution resource planning system or from work-in-process in manufacturing (view of availability through Master Production Scheduling — MPS). The entry clerk has the flexibility to promise a date from any combination of channels because he has visibility to all resources.

The coordination of distribution network requirements and manufacturing is achieved through Distribution Resource Planning (DRP). The same logic of time-phased Material Requirements Planning (MRP) in MRP II (handled by the MPS module) is extended to DRP for planning inventory replenishment in the distribution network. DRP calculates the replenishment schedules for each end item at the distribution warehouse level using data regarding policy on the relationships between distribution centers (who feeds who, who has preference and so on), sales forecasts, outstanding customer demands, current inventory and goods in transit. While the DRP system calculates the schedule, the execution of the plan requires action by the distribution inventory manager to authorize the movement or replenishment of inventory.

In an integrated demand management environment, the order entry system is responsible for all shipping activity — from releasing orders for shipment and cutting the shipping paper to triggering the billing function and appropriate journal entries to the general ledger. It is the order entry system as well that captures and posts actual demand back to the sales forecasting system.

On the manufacturing side, the scheduling of production is calculated by MPS in the manufacturing system. In the integrated demand management environment, this is greatly aided by input from DRP. DRP picks up where MRP II leaves off — at the shipping docks. With input from DRP, the MPS module in the manufacturing system massages data concerning forecasts, outstanding commitments, current inventory levels and replenishments already in progress. MPS calculates a three-year production plan. As planned production moves within the critical path time frame, the MPS module recommends actions (release of manufacturing orders, commitment of capacity and so on) that must be initiated by the master human scheduler.

Once the finished goods enter the distribution network in the integrated demand management environment, they are tracked by advanced inventory management features in the manufacturing system. These features include random storage to the detail level of aisle, bay and bin; allocation and picking; cycle counting; inspection; lot tracing; and whether inventory on hand is available to promise or

"Everybody wants to sell me an MRP system, but nobody wants to stick around till it works."
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ORGANIZATIONAL STRATEGIES

not. These features, particularly random storage and allocation and picking, greatly improve the efficiency of inventory management throughout the manufacturing/distribution network.

The random storage feature identifies all storage locations for the requested items, and the allocation policies and picking features specify the most efficient method of satisfying demand. It is the advanced inventory management features that trigger issue transactions that maintain the on hand balance status reflecting the most current activity. This integration closes the information loop and enables order entry personnel to quote reliable available-to-promise delivery dates to the customer.

Assemble-to-order operations make both consumer and industrial products. Examples of consumer products include furniture and automobiles; industrial products include electronics and instrumentation among others. The frequency of customer orders ranges across the spectrum from low to high, but the product mix is broad as with make-to-stock discussed above. The primary business issues include the ability to manage product configuration planning properly and the servicing of customer orders.

The sequence of events begins here with the master production schedule in the manufacturing system. The MPS is calculated for families of products rather than finished end items. (It is easier and more useful to plan for broad families without calculating all the various product configurations to the detail level.)

When an order comes in, the order entry clerk keys in the model number and the quantity requested. The order entry system retrieves the planning bill of material from the MPS module along with relevant available-to-promise information for all options. The order entry clerk checks off the options desired and gives the customer a tentative shipment date. When the delivery date is acceptable to the customer, the clerk processes the order as a firm planned order and the system passes that information to the manufacturing system, which plans and controls the production of the order.

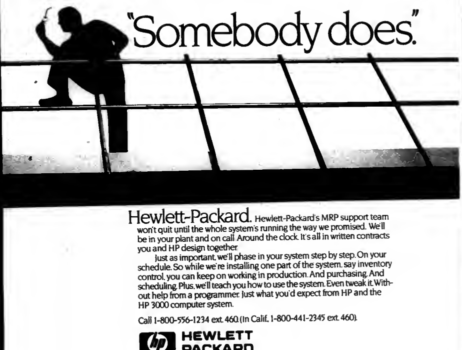
As production progresses, the reporting transactions in the manufacturing system post progress updates to the order entry system. When the order is completed, the manufacturing system notifies the order entry system that the order is ready to be shipped. The manufacturing accounting features in the manufacturing system generate the journal entries to the general ledger.

As in the make-to-stock environment, the order entry system handles the cutting of the shipping documents and the invoice. The order entry system also updates its own records including the processing of the invoice and the sales/accounts receivable journal entries to the general ledger. The order processing system also notifies the manufacturing system that the order has been shipped so that the manufacturing system can close its records on the order. The manufacturing accounting features format the journal entries regarding cost of goods sold and credits the order to shipping inventory. Once again, the information loop is closed.

In order to make manufacturing a strategic component of the corporate business plan, MIS professionals must take the initiative. Their function within the corporation enables them to view the business as a whole.

Demand management is the next major milestone in information systems integration in manufacturing. The benefits of viewing the total demand on resources include improved capacity utilization, reliable available-to-promise dates and improved efficiencies in the physical distribution of finished goods. Given the new global market realities of the 1980s, with increasingly competitive price, quality and service standards, the issue is economic survival.

Dicasali, vice-president, Management Science America, Inc., is responsible for the company's Manufacturing Systems Division in Winston-Salem, N.C., which designs and develops integrated manufacturing resource planning (MRP II) software for repetitive, job shop and process industries.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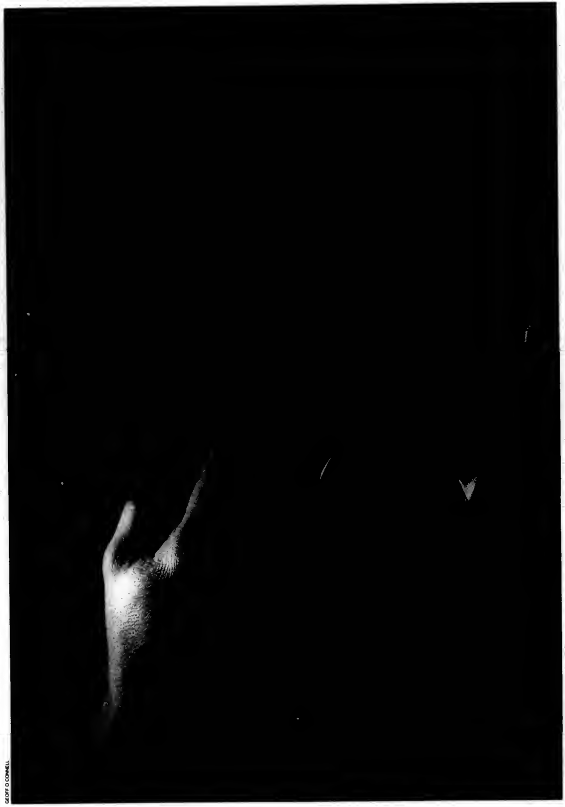


GEOFF O CONNELL

Users Move Toward MAP

• BY • STAN • KOLODZIEJ •

The Manufacturing Automation Protocol (MAP) industrial networking standard has generated a lot of discussion, but is MAP really anything more than a buzzword? Is anyone out there really using it?

At a recent MAP Users Group meeting in Toronto, MAP user installations were still in short supply, but the number of user pilot projects discussed and being put in place seemed to be growing quickly. So are the numbers of vendors entering the market with MAP products.

This year promises to be a watershed for MAP. IBM surprised many people when it used the Toronto get-together as a platform to announce its entrance into the MAP market through a joint development agreement with Industrial Networking, Inc. (INI), a Santa Clara, Calif., MAP network vendor, which itself is a joint project between Ungermann-Bass, Inc. and General Electric Co.

IBM only announced its entrance and left vague what products would be forthcoming. Traditionally, IBM enters an area only after that market has been firmly established, so the announcement helps cast an aura of credibility to the emerging MAP market.

IBM's move also takes on more significance in light of Digital Equipment Corp.'s announced joint agreement with Concord Data Systems, Inc. (CDS), the established Marlborough, Mass., MAP vendor to develop 10M-bit/sec MAP interfaces to DEC's Microvax computers. DEC's strong presence in industrial automation will put pressure on IBM to avoid being frozen out early from what is shaping up to be the primary vehicle for U.S. industry's push toward reautomation by the year 2000 and beyond.

In between IBM and DEC has come a flurry of MAP product introductions from other computer vendors anxious to provide MAP interfaces for those users beginning to plan MAP pilots on top of existing in-house networks.

Vendors with already strong presences in industrial automation (such as Motorola, Inc.; Allen-Bradley Co.; Honeywell, Inc.; and Fairchild Data Corp.) are launching MAP component products in 1986. These companies represent the vanguard of what is becoming a scramble to provide interface devices between their own products and the MAP IEEE 802.4 token bus network standard that serves as the MAP backbone.

In the meantime, however, there is understandably some confusion on the part of users. In the first place, the IEEE standard supports data communications rates of 1M bit/sec, 5M bit/sec and 10M bit/sec, though some industry analysts suggest MAP will be operational at the full 10M-bit/sec rate only.

Confusing the issue are the various MAP network specifications, a series of testing parameters by which the MAP industry polices vendor conformity and claims to MAP compatibility. Under the current MAP 2.1 specification, a facility called the Industrial Technology Institute in Ann Arbor, Mich., acts as a sort of MAP Underwriters Laboratory, granting approval to those vendor products that have passed MAP conformity tests.

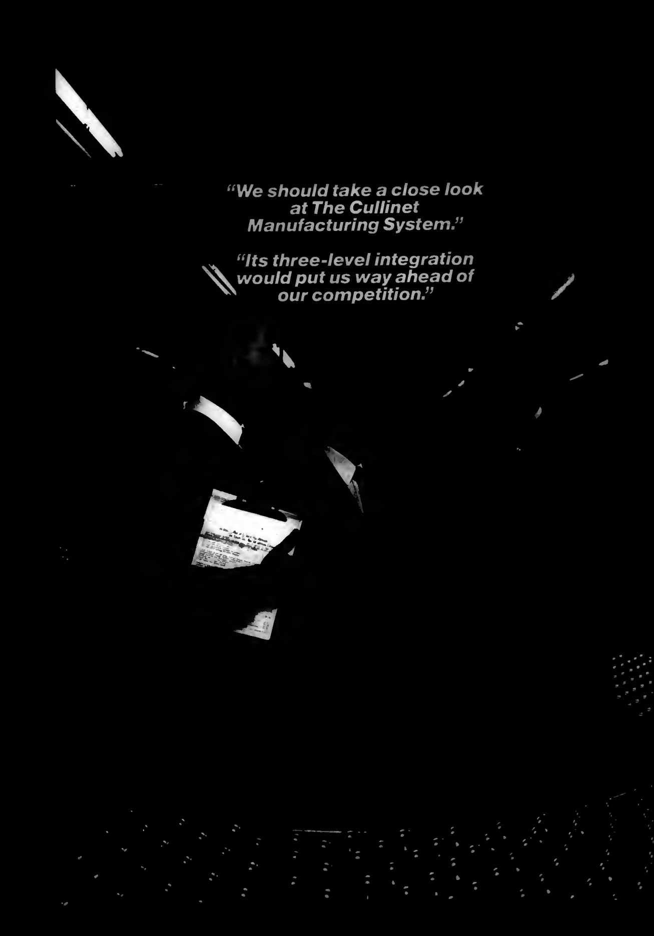
Also muddying the waters are the seven layers of the International Standards Organization (ISO) Open Systems Interconnect format on which MAP is based. The first four layers of this standard comprise the physical connect and transport layers while the top three layers involve software. At this stage of MAP product offerings, most products being introduced cover the bottom four physical layers while the top three layers — data translation, restructuring and application — are still very weak and far from standardized, a situation that has surprised some users.

Nonetheless, a growing number of users now feel the time is right to start putting the MAP pieces into place. Bill Renbargen, senior technical analyst at Whirlpool Corp. in Evansville, Ind., for example, is overseeing a MAP pilot installation project in its automatic washer assembly division. The pilot will involve interfacing both the division's IBM mainframe-based production and material control system and a Honeywell-based quality control and production scheduling system to a MAP standard local-area network supplied by Honeywell.

Though the pilot is scheduled to be in full production by August of this year, Renbargen said that "everything from the gateways down" has not been implemented yet.

"It shouldn't be a problem integrating [IBM's] SNA [System Network Architecture] to the MAP network," Renbargen explained, "because SNA is a stable protocol. It's the [physical] link to MAP that needs to be stabilized."

Another project, perhaps unique at this point, is a MAP installation at a Kaiser Aluminum and Chemical Corp. forging plant in Erie, Pa. It is one of the few existing examples of a MAP installation that is not a pilot project, but an actual working configuration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Cullinet's complete manufacturing solution is based on this three level integration. The result is a comprehensive Fourth Generation Manufacturing system that delivers the tools you need to address today's most critical business requirements, make decisions on the latest information and respond to the challenging environment of today and tomorrow. Only through the complete integration of Cullinet's **manufacturing solutions** with its **information center** and **database management system** can you gain a lasting competitive advantage.

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installed by a company without direct vendor ties to MAP.

In operation since July 1985, the Kaiser MAP project is a 6,000-foot CDS Token/Net broadband network that is handling both financial and process control operations for the plant. CDS Token Net Interface Modules (TIMs) connect over 150 multivendor devices including programmable and process controllers, computer-aided design and manufacturing (CAD CAM) workstations, terminals and personal computers to the network, which is driven by a Data General Corp. MV 10000 computer.

William Geibel, staff electrical engineer at Kaiser's Pleasanton, Calif., Center for Technology, was in charge of the Erie plant MAP installation. Geibel explained that the plant dates from World War II and was a confusing array of controllers, computer terminals and telephone wiring before the MAP project got underway. Geibel was called in and immediately set about to find vendors that could scrap the existing system and cable a network to string all the equipment together efficiently. Geibel settled on the Token Net network from CDS, then approached his superiors about installing MAP

"MAP was still basically an ideology when we started putting it in," Geibel explained. "The trouble is that when you mention MAP, the first thing people have to do is define what they think it is. Getting the concept and making people look ahead to the future as to what MAP could accomplish, how it would save them money — that was a tough selling job."

Geibel persisted, introducing a creative financing scheme that would defray much of the network cost through an energy management system. Management agreed with the proposal. "The network is not set up in a realtime process control sense, it's more event-driven," Geibel said. "I don't think MAP will truly become realtime until maybe 10 or 20 years down the line. The technology isn't to the point yet where I think people will design MAP other than for slow processes, where they can get feedback and assure that everything is following the clock."

Geibel did express concern that the current trend in the MAP industry toward vendor consolidation and working agreements (Allen-Bradley Co.'s purchase of 3M Co.'s networking division and GE's coformation of INI are two examples) will restrict user choice. "Fairchild [Data] has made an agreement with CDS, Intel [Corp.] has made an agreement with GE and DEC has agreed to buy CDS front ends to get into MAP," Geibel said. "Everything is tending toward consolidation, and I don't see new players jumping into the area of providing everything."

On the other hand, Geibel added that consolidation would not be such a bad thing if vendors could reach the point where they could get together and share the market and make their equipment compatible. "I'd be happy buying from several vendors if I could," he said.

Susan Baumann, product marketing specialist for communications products at GE in Charlottesville, Va., said her company has several MAP pilot projects scheduled for 1986 and 1987. "The problem is that even the so-called real MAP installations that have been discussed aren't truly full MAP implementations," Baumann said. "They involve running virtual terminals over a token bus network on the 802.4 protocol."

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Two MAP pilot projects are soon slated for The Boeing Co.'s Military Aircraft Division in Wichita, Kan. The company plans to layer MAP 2.1 networks on existing broadband networks operating in the Boeing Electronic Assembly Manufacturing (BEAM) and Robotically Enabled Assembly Cables and Harness (REACH) projects, the first handling electronics assembly, the other aircraft harness manufacturing.

"The equipment will be installed this year for the BEAM project and for parts of the REACH program," Chuck McCain, MAP user group chairman at Boeing, explained. "Both should be fully operational in 1987. The backbone MAP networks will be about 300 feet and will be connected to our existing plantwide cabling network. We'll be using INI to connect IBM Series/1 computers." McCain added that the plan eventually calls for integrating Boeing's TOP office networking standard with the MAP networks.

McCain said he does not see the current string of vendor consolidations as negatively affecting the MAP user. "Even though DEC is going with a CDS data set for its VAX systems, INI is still developing a board that will allow them onto a VAX network and so on. There are similar things going on behind the scenes that won't impinge on the user environment.

"I see these initial things that INI and CDS are doing with IBM and DEC as a sort of foot in the door, looking for a competitive edge in the short-term until everybody gets interoperable and people have figured out how to make those connections between whatever they're producing and VAX and IBM equipment."

McCain also viewed IBM's announcement as a necessity. "The problem IBM has is that DEC is making such big inroads into the manufacturing industry. We have DEC VAX 11/780, VAX 11/785 and 8600 computers all over our [Wichita] factories in manufacturing production. Our big business systems run on IBM, but everything below that is pretty much DEC. I think it's a marketing strategy on IBM's part because they can see DEC making gains and moving them out, so IBM has to do something now."

Another company heavily involved with MAP is the Eastman Kodak Co. in Rochester, N.Y. Kodak is currently installing a MAP-based production control system tying together IBM mainframes and DEC VAX 11/780s through INI interfaces. The pilot is scheduled to be in operation this July. Also being considered is a MAP-based flexible manufacturing system tying together IBM Personal Computers used as production cell controllers.

Charles Gardner, director of information services at Kodak and head of the industry MAP/Technical and Office Protocol steering committee, made it clear why his company is pushing toward MAP. "The benefits of MAP include better use of technical resources, reduced development and maintenance costs, less customization, more flexibility and shorter development lead times. We've established that 50% of the total costs of factory systems are communications related. One communications standard like MAP will cut costs across the board."

As for the seventh layer of MAP, the actual software applications layer, Gardner said that developers of MAP products should not concern themselves too much with the current lack of MAP applications. "The main thing is to get the [MAP] pieces in place," he explained, "and users will fill the applications gap."

Gardner offered some advice for companies thinking of taking the step to installing a MAP pilot: "Use key vendors, involve key designers, try to stay within schedules, keep the project visible and accessible to in-house personnel and be prepared to train those interested in learning about MAP."

With the influx of new MAP vendors, and more users, the spotlight has temporarily been taken away from General Motors Corp. Though the automobile giant keeps actively pushing ahead with MAP installations, most notably in its Detroit-Hamtramck and Saginaw, Mich., assembly plants, its days as the sole promoter and force behind MAP and MAP pilot projects are most likely gone.

Other companies are taking up the slack. IBM's Toronto MAP announcement, for example, followed IBM's commitment to install MAP pilot projects using IBM Series/1 minicomputers and IBM-produced MAP connectivity software in its assembly plants in Endicott, N.Y.; Lexington, Ky.; and Richmond, Va.

The Endicott facility produces computer chips and circuit boards and assembles IBM's 4300 Series mainframe computers. The IBM plant uses a photographic process to imprint circuits on the chips and boards, while a wet process comparable to photographic development is used to place conductive material on the exposed areas of the products. The MAP pilot will monitor process data on a realtime basis using an IBM host computer, five IBM Series/1 computers and 10 PCs used as graphics workstations. The MAP backbone is a CDS 802.4 Token/Net network.

The John Deere Harvester Works has been actively promoting a MAP pilot at its East Moline, Ill., assembly plant. The farm equipment manufacturer is also using a network from CDS to connect a direct numerical control unit in its computer center to some numerical control fabricating machines located out in the plant. The network allows operators to access, change and call down part programs to the machines. A future application will have the network controlling product quality in automated spot welding operations.

Another significant announcement is that Honeywell will install two internal MAP pilot projects in 1986, one a shop floor control pilot at the company's Phoenix, Ariz., facility, the other a flexible automation pilot linking work cell and programmable controllers at the company's Gardenia, Calif., manufacturing site. Both these projects are intended, like similar projects with other MAP vendors, to demonstrate Honeywell's dual role as a MAP vendor and MAP user.

"There's no doubt MAP vendors are spurting ahead," Whirlpool's Renbargen concluded. "But I think it might be time to hold back and let users catch up." ◼

Kolodziej is a senior writer at Computerworld Focus.

TECHNOLOGY INSIGHT

On The Shop Floor With Micro MRP

• BY • LEE • WHITE •

Just when MIS managers in large manufacturing facilities are getting a handle on mainframe-based manufacturing resource planning (MRP II) systems, along comes a curve ball — microcomputer-based MRP II.

But what's the advantage to the microcomputer systems? In reality, is there anything that these smaller software packages can do that the mainframe systems can't? The quick-fix answer is — probably not.

Bob Guise, senior manufacturing consultant at Comserv Corp., manufacturer of AMAPS/3000 and AMAPS/Q mainframe MRP II systems, sees mainframe MRP II operating globally with many parameters, reaching all the way from the accounting structure down to shop floor scheduling. These systems, according to Guise, are simply not capable of performing all the local optimizations necessary to make certain areas of the plant more efficient.

Guise doesn't recommend that companies drop their large MRP II systems. What he does suggest is that the smaller, microcomputer-based systems be used to model pieces of the vast amount of information resident on the mainframe. "Corporate MRP II gives you a global picture and gives you some boundaries to the problem. Within those boundaries you download data to the local areas and let the local areas use the best techniques for scheduling. Then information can be fed back, selectively, to highlight any discrepancies," Guise explained.

While the *Computerworld Focus* survey of vendors and users did not elicit the ideal situation described by Guise, the following are examples of three fairly typical microcomputer-based MRP II systems along with some users' views of the systems.

A materials requirements planning package is available from Twin Oaks, Inc. of Cottage Grove, Minn. It runs on the IBM Personal Computer, Personal Computer XT, Personal Computer AT or 100% PC-compatible computer with a minimum of 256K bytes of random-access memory (RAM).

The software is comprised of four groups: engineering, material, production and management. Modules in the engineering group establish the item record and maintain all relationships to other data base records, define the labor and operation required to complete the assemblies, define the relationships between the various materials used for the assembly of a product, accept engineering change orders or offer options and parameters that affect the logic of various programs.

The materials group provides inventory control such as stockroom issues, receipts and adjustments; produces a material list for assemblies; offers inventory reports from secondary locations; generates inventory cycle counting tickets; reports historical data; tracks balances-on-order and prints purchase orders showing cost variance between standard, current, quoted and actual prices.

Production modules control all date generation and scheduling for the work orders; create, reschedule and cancel planned work and purchase orders through the materials planning module; determine the labor by operation for a work center; schedule a day's work within work centers; and provide labor, capacity and cost information for work centers.

Management modules involve master scheduling, cost development and variance reporting, which provides cost accounting information and physical inventory, which creates preprinted inventory tickets.

Groups of MRP II software range in price from $3,375 to $8,295; modules are priced separately from $350 for the secondary description module to $1,475 for the work order module.

Bob Dahlberg, production manager at Chernow Communications, Inc. in Boulder, Colo., a subsidiary of International Telephone & Telegraph Co. (ITT), has been using Twin Oaks software on ITT Extras with 10M-byte hard disks. He is about to network the four computers on which MRP II runs.

Although Chernow Communications, which manufactures telephone call accounting systems for hotels, currently has a DEC VAX

750. Dahlberg decided that a microcomputer-based MRP II system was preferable to one running on the VAX. "To get roughly the same muscle that I've got with Twin Oaks would have cost me about $32,000," he explained.

Dennis Timlen, general manager of the Mechanized Electronics Assembly Division of the Specialized Electronics Products Group of Universal Instruments Corp. in Binghamton, N.Y., noted deliveries improved by 50% and inventory turns saw a 100% increase after implementation of Twin Oaks. However, Timlen expects his company will move up to a mainframe-based system because response time on the microcomputers is poor. "We're getting maxed out because of the Cobol compiler limitation," he said.

But Bruce Peterson, manager of information services for Johnson Wax Associates, a division of S.C. Johnson and Son, Inc. in Racine, Wis., another Twin Oaks user, thinks microcomputer MRP II systems definitely have a place in Fortune 1000 companies. "Not every operation within a business can afford a highly sophisticated manufacturing control system. For $18,000 [in hardware and software] a small $5 million manufacturing operation can get some computer power behind it," Peterson said.

MFG Software Corp., a subsidiary of Microtechnology Sources, Ltd., developed Fourth Shift manufacturing software for micros. Interestingly, this product was spun off by Comserv because a microcomputer-based product presented marketing problems that its sales force would find difficult to overcome.

Fourth Shift offers a data base manager and a user interface to provide on-line assistance. The hardware required to operate Fourth Shift is the PC XT, PC AT or PC-compatible computer. 512K bytes of RAM is recommended for most modules.

Fourth Shift modules include system control, general ledger, accounts payable, accounts receivable, inventory control, product costing, bill of material, purchasing, material requirements, order entry, job shop (which includes resources management and custom products) and multiuser/local-area network modules. Modules may be purchased separately and range in price from $195 to $4,995.

The California-based Dracon Division of Harris Corp., whose Chatsworth plant is a make-to-order sheet metal fabrication facility, is a beta test site for Fourth Shift. Their problems are somewhat unusual in that they provide materials on a Just-in-Time basis to its electronics and manufacturing facility in Camarillo, Calif.

Tom Houston, operations manager, saw the package in 1984 and was impressed with its functionality. In addition, the package made sense for their particular method of manufacturing. "Because of our Just-in-Time techniques, sometimes we have to run product lines like separate businesses," Houston explained. Houston also liked the ease of implementation: It took over two years to implement a mainframe MRP II system at company headquarters.

Micro-MRP, Inc. offers an MRP II system called Max, a closed-loop planning production and control system. Max runs on a PC, PC XT, PC AT or 100% PC-compatible computer in either a single- or multiuser system. It requires 320K bytes of memory and hard disk storage. The system is menu-driven and has help screens.

Max is comprised of three groups of fully integrated modules. The foundation group includes bill of materials, inventory control and interface modules. Bill of materials is used to create and maintain information about the structure of products. Inventory control maintains inventory for on-hand quantities for each part while the interface module provides two-way load/unload access to data stored in Max. Interface allows users to download Max data and use other software or custom-written programs to manipulate data, write customized reports or communicate with mainframes or minicomputers. Interface also includes the capability to bulk load data directly into Max and perform a mass update.

The planning module consists of Master Production Scheduling and MRP II. Master Production Scheduling plans production for finished goods or customer items covering the total lead time required to build the item from scratch. Master Production Scheduling is manually implemented based upon a combination of forecast demand, actual customer demand and available plant capacity. MRP II then extends Master Production Scheduling for finished goods down to lower-level assemblies and parts.

Purchasing Control, Shop Floor Control, Costing and Management Performance make up the Control Module. Purchasing Control is used to monitor and control the priorities of planned and released purchase orders. This module responds to changes in the MRP II Module and communicates the changes to vendors through the purchasing operation. Shop Floor Control coordinates orders for assembly and monitors cost information. Management Performance provides reports that analyze productivity. Max modules are priced separately from $6,000 and maintenance fees are extra. The complete bundled set costs $19,200 with a maintenance agreement of $2,300.

Caere Corp. in Los Gatos, Calif., is a manufacturer of bar code scanners and optical character recognition equipment. Robert Glen, manufacturing engineering manager, has had extensive experience with mainframe MRP II systems and thinks that Micro-MRP compares favorably with the larger mainframe installations and in some respects is better. "In larger installations you have to work through an MIS group whereas here you are more or less in charge of your own destiny," he said. In fact, while Caere does have a Hewlett-Packard Co. 3000, there is no MIS department "in the classical sense," Glen said.

The Becton-Dickinson & Co. plant in Salt Lake City is unique in that the Micro-MRP system runs on 22 IBM, Compaq Computer Corp. Compaq and Eagle Computer, Inc. Eagle computers tied by 300M bytes of hard disk storage and 4M bytes of main memory on a Novell, Inc. network.

Scott Lindgren, plant MIS manager, chose Micro-MRP primarily for cost considerations. "We had an HP 3000 series 48 running Comserv. The typical syndrome of the mainframe is when you run out of capacity, you go out and buy another mainframe and then go through a one-year conversion. With the micro concept, all I have to do is purchase another network, tie it to the old one, add 24 more users, 500 megabytes of disk storage, 8 megabytes of main memory and up to five more printers," Lindgren enthused.

Lindgren's installation is a real success story. When he got rid of the HP 3000, he cut his MIS budget by two thirds and his staff from seven to three, including himself. While Lindgren says his objective is to work his way out of a job, this kind of bottom-line performance might be more likely to land him a vice presidency.

While the subject of microcomputer-based MRP II systems may bring up questions of technical capabilities, the biggest question in the minds of most MIS directors, of course, is: How will microcomputer-based MRP II systems affect MIS department resources?

Harris' Houston who has been on both the mainframe and microcomputer side of MRP II systems, thinks the reaction will be mixed. "Typically, the micro packages do not require any MIS involvement while [MRP II on the mainframe] can't be done without the MIS staff. So on the one side you've got the MIS guy wanting to keep his job going and on the other it's real easy for him not to have to get involved. There's going to be a trade-off," Houston suggested.

Becton-Dickinson's Lindgren sees the combination of personal computer networks and MRP software as the wave of the future and predicted that large mainframe sites will decrease. A data processing professional for the past 15 years and an active participant in migrations from an IBM 1620 through the 360 and 370 series and into many DEC VAX and HP installations, he welcomes the change to the age of the microcomputer and individual departments' responsibilities for implementation and maintenance.

"Most MIS departments have a tendency to try to create an empire. But when you start saying, 'Hey, you don't need that empire to facilitate the needs of wherever you're at,' you're invading their turf. I used to be there myself. I don't feel that way anymore," he concluded. F

White is a senior writer at Computerworld Focus.

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CIRCLE READER SERVICE NUMBER 111

Microcomputers In The CAD/CAM Arena

DAVE RIDLEY

·BY·ELIZABETH·J.·HEICHLER·

Access to computer-aided design (CAD) tools has never been as widespread as it is now. Many small engineering and architectural firms are investing in design automation for the first time, and increasing numbers of colleges and technical schools across the U.S. offer courses in the subject. Longtime CAD users like those in the automotive industry are beefing up installations, with the goal of putting a personal workstation on each designer's desk.

What's behind this explosion in CAD usage? One factor is the emergence of low-cost personal computers that have slowly but steadily gained acceptance. Critics initially scoffed at the idea of running engineering applications on what was at first considered a toy. As more powerful personal computers, most notably IBM's Personal Computer AT, came on the market, the very effective — and very inexpensive — performance of personal computer-based CAD became apparent.

Personal computer-based CAD currently represents the fastest growing segment of the CAD marketplace. Personal computer-based systems are increasing from 1% of total mechanical computer-aided design, manufacturing and engineering (CAD/CAM/CAE) revenues in 1984 to 33.8% in 1990, according to International Data Corp. (IDC), Framingham, Mass. Engineering workstations will also represent 33.8% of revenues in 1990, up from 20.8% in 1984. Host-based systems, on the other hand, will take a dive from the 1984 figure of 66.4%, accounting for only 13.7% of mechanical CAD/CAM revenues in 1990, according to IDC.

The rapid rise of low-cost solutions in this industry will force the total revenues to decrease 4.3% from 1984 to 1990, according to IDC predictions. To say that this will have a significant impact on traditional turnkey CAD vendors is an understatement. These established companies must react now to the inevitable drastic shrinking of profit margins. The rules are changing, and companies that have grown fat selling turnkey systems at $100,000 apiece will have to change the way they do business.

Perceptions of what CAD is and how purchasing decisions are made are changing too. Typical configurations in the early days of CAD were mainframe-based systems. These were most often found in advanced engineering environments such as aerospace and automotive companies, where high levels of complexity in the design process made design automation a necessity.

Buying CAD has traditionally meant a large capital investment. It's also a major corporate commitment to a sophisticated technology, with many less apparent costs like training and support attached to it. For these reasons, CAD purchase decisions are usually made by top management and often involve both the engineering department and MIS department in system evaluations and recommendations. In a large company where integration of CAD with manufacturing, financial tracking, business planning and other systems is needed, this level of corporate control is justified to ensure that CAD will tie into the whole organization.

Personal computers and accompanying software, however, are a comparatively small purchase and often one that can be authorized by the end-user department. Adopting CAD can now be a small-scale experiment, with scattered departments and individuals buying personal computer systems on their own. While increased drafting quality and productivity generally result, the organizationwide benefit of having a common design data base is jeopardized. Proliferation of isolated personal computer CAD systems is exacerbated by the fact that, in many cases, personal computers are already present in engineering offices. Software for two-dimensional drafting is now available at prices under $500, so it's relatively easy for an engineer to acquire software, a graphics board and digitizer or other input device. If enough end users take this approach, MIS will certainly develop severe headaches over networking and data base management.

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Problems caused by proliferation of personal computers, however, have been partially stemmed by the entry of CAD/CAM's big guys into the personal computer CAD market. These major vendors did not jump eagerly onto the personal computer CAD bandwagon until user demand required it. When companies like T&W Systems, Inc. and Autodesk, Inc. pioneered personal computer CAD, it was barely taken seriously, much less considered worth integrating with other systems. As this low-cost technology proved itself in architectural offices and small engineering firms, it gained credibility through the experiences of satisfied users.

Soon CAD users' skepticism turned to interest, and from interest to demand for low-cost tools. Vendors watched users acquire inexpensive CAD systems, some of which even had interfaces to mainframe CAD systems. It didn't take long for the vendors to catch on to what users really needed: low-cost, front-end workstations integrated with more powerful CAD and CAE systems. Numerous companies have since brought out CAD systems for personal computers that are tied into the upper ends of their product lines.

> *Personal computer CAD can be a productive and economical front-end tool. However, its proliferation should be closely watched by MIS.*

One of the traditional turnkey vendors providing personal computer solutions is Computervision Corp. Computervision now has a line of bundled systems ranging in price from about $13,500 for a mechanical design and drafting system to about $24,000 for an advanced Personal Architect system. These systems are linked to larger Computervision systems by means of a file transfer capability that allows direct transfer of binary and text files from personal systems to Computervision's CDS 4000 and Designer V-X. Also, part of every advanced personal system configuration is Personal CADDS Connect, which provides emulation of a CV CADDS 4X Instaview terminal.

Manufacturing and Consulting Services, Inc. (MCS) has a two-dimensional mechanical drafting and design package called Anvil-1000MD and supplies interfaces to its other Anvil systems as well as an Initial Graphics Exchange Specification (IGES) interface. IGES, the imperfect but necessary data exchange standard for the CAD/CAM industry, has been one way for personal computer CAD vendors to open up their systems, allowing files to be uploaded to mainframe systems that can read the IGES format. Another strategy has been to write direct interfaces to popular CAD systems where possible.

Computervision and MCS are two of the many CAD/CAM vendors that have ported their software to personal computers. The result of a vendor's pressing need to fill out the low end of a product line is that now everything from two-dimensional drafting software to sophisticated applications like finite element analysis and solid modeling are available on personal computers.

Users who have accepted personal computers as automated drawing boards are now skeptically eyeing this advanced software. Where does vendor hype end and legitimate uses for personal computers in the CAD/CAM world begin? The answer to this question is clouded by the continually improving performance of personal computers. The AT's speed compared to earlier personal computers caused users to reevaluate personal computer CAD's capabilities. In fact, many industry observers see the distinction between low-end engineering workstations and personal computers disappearing altogether.

Obviously, personal computers cannot replace host-based systems, especially not in any fairly large company engaged in design for manufacturing. They have, however, undeniably earned a supporting role as the preferred tool for front-end applications like drafting. One particular advantage they have over host-based systems is their autonomy: system performance is not degraded as it is when a number of users busy at their CAD terminals slow down the response time of a host system.

As CAD tools have become popularized, the traditional vendor-user relationship and direct sell have been replaced by distributors and retailers. The vendor can no longer afford the level of service and support that went with high profit margins and sophisticated mainframe systems. Volume is needed to turn a profit on the inexpensive personal computer-based systems, and service and support is now generally considered the responsibility of retail dealers.

Common sense decrees that selling CAD systems requires more specialized training than selling word processing or spreadsheet software off-the-shelf. What qualifications does a dealer need to perform a responsible job of selling and supporting personal computer CAD? Several micro CAD dealers and vendors that were contacted provided their perspectives on this question. Both groups thought personal computer CAD can't be sold as an off-the-shelf product.

Selling CAD is more complicated than selling common business software. Most dealers are familiar with how a typical business operates, but they have no idea how an engineering office functions, one dealer noted. If dealers are to do a good job, they must receive training that teaches more than just how the product works.

Users' expectations often need to be reeducated, and this is where a dealer's CAD experience is especially useful. The salesperson should also make it clear to the customer what the vendor can provide now and steer people away from depending on features due in an upcoming release.

The personal computer CAD customer and user should choose a computer dealer as thoughtfully as one selects a software package. The dealer will be the main source of service and support and so should understand the user's needs and applications and have the resources and commitment to come through. There should be some channels of support from the vendor as well, even if only a hot line to technical support people.

Key issues in personal computer CAD system selection encompass both hardware and software. Dan Smith and Eric Teicholz in their book *PC CADD: A Buyers' Guide* (Graphic Systems Inc., Cambridge, Mass.) point out some of the following important factors:

- Computer architecture influences a system's response time. A 16/32-bit CPU such as the one in the AT coupled with a math coprocessor is desirable to speed up computations.
- Data storage is accomplished using both internal and external memory. Internal memory is the fastest, but usually limited in expandability. External Winchester hard disks will hold 5M to 40M bytes of memory. Floppy disks are most appropriate for archiving infrequently used data.
- Data base geometry must be considered. Does the user need two-dimensional drafting capabilities only, or is three-dimensional a requirement? If 3-D is necessary, a more powerful system such as the AT should be used to provide adequate response time.
- Drafting capability and user interface affect not only how easy a system is to learn but how productive it is once learned. Documentation, help commands and command menus should be evaluated for ease of use. Important drafting capabilities include automatic dimensioning; ability to segregate graphic objects into overlays using at least 64 layers that can be turned on and off independently; ability to customize menus; display capabilities such as dynamic zoom, pan and multiple drawing windows.
- Macros and command files can save large amounts of time for designers, especially when performing similar repetitive operations.
- Displays should have as high a resolution as possible. An important piece of hardware is a graphic processor that can boost the display's resolution. Other graphic controllers support drawing rotation, translation, polygon fills and 3-D clipping.
- Input devices include keyboards, digitizers, mice and light pens.
- Networking and upward migration are two of the most important issues for users. The system should be able to grow with the user's requirements, and the system should support a local-area network that is relevant to the other systems already in place.
- The ability to perform file transfer between different programs allows users to interface spreadsheets or project management with their CAD system. This further takes advantage of the fact that personal computers can be used for many nondesign tasks.
- System management issues that should be evaluated as a matter of course include ability to perform drawing backup and retrieval from disk or tape; ability to copy, rename and delete drawings; types of drawing security provided and types of job accounting performed.

Assuming personal computers will inevitably become a part of most CAD/CAM installations, MIS should at least be prepared to monitor their purchase. Vendor service and support of these systems is minimal — certainly nothing like the handholding that comes with mainframe CAD. Taking care of user problems will probably fall to MIS, so it's important this department know how the personal computer systems are configured and how to integrate them with existing systems.

Personal computer CAD can be a productive and economical front-end tool. However, the proliferation of personal computer CAD systems in a large organization should be closely watched by MIS. If personal computer CAD is not made part of a long-range CAD/CAM strategic plan, systems integration and control of scattered data bases may become problematic. ◆

Heichler is editor of CAD/CIM Alert *newsletter and* PC Software and Systems Directory for Computer-Aided Engineering, *published by Management Roundtable, Brookline, Mass.*

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CIRCLE READER SERVICE NUMBER 113

Integrating The New Mix

DAVE RIDLEY

· BY · JOEL · ORR ·

You're an MIS manager for a manufacturing firm. One day you will look around, for the first time in weeks, and be astonished to see computing systems of all sizes and shapes. Micros, minis and even a couple of respectable mainframes will have moved in while you weren't looking.

They will be run by engineers and manufacturing personnel, each of whom bought a system to solve some gnawing problem in their area of responsibility. About one third of them will be doing what they were supposed to do; the remainder will be adding to the confusion rather than reducing it, or not running at all.

As you begin to investigate, you will learn that the buyers of the systems got around corporate computer purchasing policies by not calling the systems computers. Instead, they were listed as drafting machines, numerical control systems, lettering devices — almost anything that didn't include the words computer or data processing system. The smaller ones never reached the capital equipment appropriation board because their prices were below the threshold. The larger systems were all leased or rented.

You wander from area to area in growing consternation. At each system, people turn to you with angry questions: Why can't your computers communicate with our system? What's wrong with your antiquated installation? Your empire-building attitude is destroying the company! Several of the questioners begin to make angry gestures and shout. You quicken your pace down the hall. You feel cold and clammy, droplets of sweat appear on your temples. You resist the temptation to turnaround as you hear the mob drawing closer behind you.

Suddenly you break into a run. Avoiding the elevator, you tear open the door to the stairway and run up the stairs, taking them three at a time. The noise of the angry mob bursts into the stairwell, but you yank open the door to your floor and sprint toward the computer room.

As you round the last corner, a sharp pain just above your knees and a solid thunk on your forehead are the last things you feel before you lose consciousness. There you lay, sprawled across the top of your own desk that was being trundled out by two burly workmen. They look surprised for a moment, then shrug and continue toward the elevator with the desk and its burden.

Your spouse is shaking you gently and saying comforting things. It is only a dream.

What's going on? Why are computers spreading like a plague in manufacturing companies? Why is MIS often excluded from the process? And what should the MIS manager do about it?

Automation is what's going on. U.S. manufacturers are waking up to the fact that their continued existence depends upon reducing the labor component of the cost of their products, increasing their quality and reducing the amount of time to produce new designs. And they must make these changes within months. Automate, emigrate or evaporate were listed as the choices available to U.S. industry a few years ago by the president of General Electric Co.; the situation is even more critical today.

Clearly, computers must play a key role in this process of change. The problem is that management in manufacturing firms is disillusioned with computers. At the same time, their understanding of the potential of these machines is imperfect. Net result: Low-quality corporate decisions regarding the spread of computers.

So they sneak in and creep in because they are so inexpensive. Before a company has time to establish a policy or a standard, there are dozens of personal computers, minis and even mainframes around — some of them compatible with each other, others unique; some running commonly used codes, others with unheard of spreadsheets, word processors and special purpose programs.

In engineering, it often starts with personal computers that are acquired to do things MIS couldn't get around to. Then come the drafting programs — packages ranging in price from $200 to

SPECIAL SECTION: CAD/CAM

$5,000, necessitating full-memory complements, hard disks and plotters. But each device has fallen well within the purchasing authority of some department manager, and hence has not drawn the attention of those bodies within the organization whose responsibility it is to maintain the integrity of the information processing environment.

Then there are the full-blown computer-aided design and drafting (CADD) systems — Digital Equipment Corp. VAXs, Hewlett-Packard Co. 9000s and Prime Computer, Inc. 9650s — purchased without the benefit of MIS advice or consent because they are simply engineering tools. So much for engineering.

In manufacturing, systems for programming computer-controlled machine tools contain 8086-based board computers, personal computers or computers the size of Data General Corp. MV-8000s. These units may be as simple as text editors or as complex as CADD systems; they are used to turn out part programs, which are sets of instructions to numerical control (NC) machine tools.

Many other computers are at work in the factory, often without the knowledge of MIS. An important example: The original use of the acronym PC was programmable controller — a device that is essentially a rugged, special-purpose computer invented and promoted by Dick Morely, chief scientist for Gould, Inc. Programmable controllers are used to operate a broad range of devices within the factory, ranging from valves to conveyor systems, from furnaces to robots.

And speaking of robots, each one contains at least one main computer and several subsidiary systems. Most robots require dedicated programming systems for planning and creating the programs that define their operations. Material handling systems, from automated warehousing units to unmanned vehicles, are all computer-controlled.

In short, computers are found in all parts of the manufacturing company — and they must be integrated. Their owners want them to be able to exchange information. They want a centralized drawing control system, and they want paths for sending geometric data directly to manufacturing. CADD system users want to be able to share expensive peripherals and to receive CADD data from and transmit CADD data to the company's suppliers and customers.

Now it's up to you. You're the computer expert, aren't you? So tell us how to make it all happen. And don't tell us what we should have done. We have invested lots of time and effort in our data bases on these disparate systems, and we don't want to hear that we have to convert them all.

To develop meaningful solutions to this set of problems, you have to have an understanding of how they came about. The first CADD/computer-aided manufacturing (CAM) systems were purely experimental and ran on the only computers available at the time that could do the job.

But in 1970, the first commercially successful CADD systems came out on the just-born minicomputers. Computervision Corp.'s CADDS 1 ran on a DG Nova, while Applicon, Inc.'s early AGS ran on the DEC PDP-11. Both systems used cassettes for storing individual drawings, in the days before diskettes.

Today's systems are as far ahead of those pioneering products as the computers on which they run. Computervision, for example, runs CADDS 4X on 16- and 32-bit processors of its own design while planning to move its software to Unix-based Sun Microsystems, Inc.'s workstations; Applicon has ridden DEC onto the VAX family; and so on.

There is no longer a clear distinction between minis and mainframes; word length, which has been a distinguishing characteristic in the past, is becoming uniform at 32 bits. Is a VAX 11/780 a mainframe? Is an IBM 4361 a mini? Even computers in very small packages (such as the DEC Microvax II and the IBM Personal Computer RT) have operating features that make them indistinguishable from large minis and mainframes.

All CADD/CAM vendors have come to realize that they must offer a family of processors to meet the different needs of their customers. Those that rely on DEC, offer systems on computers ranging in size from the Microvax II to the 8650. Vendors using Data General equipment tie into everything from the MV-2000 to the MV-20000. (See Figure 1.)

Applicon, Inc.	**Digital Equipment Corp. VAX family**
Autodesk, Inc. (Autocad)	**IBM PC and compatibles; Apollo Computer, Inc.; Sun Microsystems, Inc**
Auto-Trol Technology Corp.	**Apollo family; DEC large VAXs; IBM PC/AT**
Calcomp Imaging Products	**MASSCOMP workstations; IBM PC**
Calma Co.	**Data General Corp. MV series; DEC VAX; Apollo family; IBM PC/AT**
Control Data Corp. (CDC)	**CDC Cybers; DG MV series; DG Eclipse series**
Computervision Corp. (CV)	**CV CGP family and APU; Sun Microsystems; DEC VAX; IBM PC/AT**
Daisy Systems Corp	**Daisy; IBM PC**
Gerber Systems Technology, Inc.	**Hewlett-Packard Co. family**
IBM	**IBM 4300 series and larger, Series/1, PCs**
Intergraph Corp.	**DEC VAX family, Intergraph Corp. Interpro/32**
McDonnell Douglas Automation Co.	**DG MV series; DEC VAX family; IBM 4300s**
Manufacturing and Consulting Services, Inc. (Anvil)	**DEC; DG; HP; IBM**
Mentor Graphics Corp.	**Apollo family**
Prime Computer, Inc.	**All Prime computers**
Racal-Redac, Inc.	**DEC VAX; IBM PC**
T&W Systems, Inc.	**IBM PC and compatibles**

Figure 1. CADD Systems Manufacturers and Compatible Computers

Communications among these systems is an important issue. The networks promoted by the computer manufacturers are usually supported by the CADD/CAM vendors. (Because all the leading vendors provide turnkey maintenance on their systems, there are sometimes delays between the announcement of features by the computer manufacturer and the support of those features by the CADD/CAM vendors.)

One important factory communication standard is GM's Manufacturing Automation Protocol (MAP). GM's tremendous buying power has caused this protocol to quickly become almost universally accepted by vendors. It is a token-passing scheme that fits within the International Standards Organization (ISO) open system architecture that is designed for local-area network use. At present, it does not address realtime system needs or wide-area networks.

The low cost of micro-CADD systems has been a source of confusion in industry. Microcomputers have been a thorn in the side of CADD/CAM vendors since the emergence of personal computer-based CADD systems. Users buy Autodesk, Inc.'s Autocad or T&W Systems' Versacad ($2,500 to $3,000) just to learn about CADD before selecting a real system and then find out they don't need a large system.

Several of the leading vendors have announced their own personal computer-based systems. These are generally dressed up with high-resolution screens and additional hardware so they cost $25,000 to $30,000. The better ones are data- and command-compatible with the larger systems. By and large, however, there are no standard data formats, and communications is a problem.

Graphical data formats vary widely from one system to another. The formats are usually proprietary; utilities for extracting and inserting data are often provided. They tend to be verbose (whoever said a picture is worth only a thousand words never tried to digitize one.)

The Initial Graphic Exchange Specification (IGES, recently renamed PDES) presents a partial solution to the data exchange problem. It is a neutral data format, defined by the American National Standards Institute, on the basis of work coordinated by the National Bureau of Standards. Vendors provide translators into and out of IGES format, making it possible (though not always easy) to convert data from one system to another. But not all CADD data is inherently convertible; IGES is an approach to the problem, not a panacea.

Most systems have facilities for associating nongraphical data with the graphical information. ASCII is the almost universal character format. Interfaces to IBM systems are available for many vendors. These are usually programs and hardware that make the system look like a remote job entry station to the mainframe; 3270 and other emulators are also widely available.

The biggest problem in CADD/CAM data handling is simulating the manual concept of an original document. Only by maintaining a single, authoritative definition of the product can a company be assured of the data consistency that is necessary to run an effective engineering operation. Most CADD system vendors do nnt do justice to this problem and leave its solution to the oft-ignorant buyer. Remember this point when integrating systems.

The desire for integration of existing systems is a manifestation of the general move toward computer-integrated manufacturing (CIM). And it means that the organization will have to change. Because the architecture of computing systems — even engineering and manufacturing computing systems — must reflect the structure of the organization, it is very important that the systems you develop today are sufficiently flexible to accommodate the required changes. Tomorrow's system will not work today, and today's system won't work tomorrow.

Change to an entire organization can only occur through top-down initiation and support and bottom-up implementation. Like other living organisms, organizations resist change. Education, and lots of it, will be required. You will have to persuade people at every level of the organization that it is in their interest to help change the organization and that it is against their interest to resist or remain passive. To do this you must do the following:

- Get a clear picture of jobs and relationships within the organization.
- Design the future organization's architecture and locate as many of the existing people as possible within it.
- Let people participate in identifying their positions in the new structure.
- Elicit assistance in bringing the changes about from employees at all levels of the organization.

General education as to automation and its role in your organization will be necessary. For most workers, CADD and CAM are remote and sometimes frightening. Multiple doses of education, at increasing levels of personal involvement, can help people deal with the situation in a positive way.

When it comes to change, people are the difficult part of the organization; information is much easier to deal with. Here are some guidelines for dealiog with the information issues:

- Inventory: Find out exactly what systems are in place.
- Diagram: Show the existing systems and the flow of information as it exists. Then show the desired flow of information and a physical network (or combination of networks) that can handle it.
- Pinpoint: Identify the information exchanges that require translation or file conversion.
- Find: Determine if there are commercial conversion products available for all the required conversions. Get costs and product details about the relevant ones. For interchanges for which there are no conversion products, contact firms offering data conversion services.
- Plan: Prepare a complete document showing the old systems, the new systems and the required changes. Get input from all user groups. Then get management to make it into a statement of policy.

And finally, face it. A heterogeneous computer environment in the manufacturing organization is inevitable. Don't try to prevent it; prepare for it. ■

Orr is chairman and principal consultant for Orr Associates, Inc., a computer graphics consulting firm in Great Falls, Va. He has been involved with CADD, CAM and CIM for over 12 years.

Graphics Standards And CAD/CAM

DAVE RIDLEY

A veritable alphabet soup of acronyms denoting standards has sprung up in the computer graphics community. The terms are confusing to many; happily, most of them are irrelevant to users.

Only the term IGES listed below is of interest to CADD users; all the other standards mentioned have to do with graphics programming. Only sophisticated users who want to interface various devices on their own need be concerned about the extent to which programs and hardware support the other standards described below.

Here are some terms, definitions and descriptions:

ANSI — American National Standards Institute: Formerly a government body, ANSI is now run by the American Society of Mechanical Engineers (ASME).

CGI — Computer Graphics Interface: The International Standards Organization is working on a draft of this standard, which is modeled after ANSI's CG-VDI. It was formerly known as VDI — Virtual Device Interface.

ANSI's CG-VDI — Computer Graphics — Virtual Device Interface: This is a programming standard that focuses on ways to normalize the program interface to various input and output devices, primarily in interactive applications. It does not support segments, a feature available in some graphics hardware.

CGM — Computer Graphics Metafile: This was formerly VDM — Virtual Device Metafile. To pass graphical information from one program to another, a well-defined standard format is desirable. CGM describes such a format, which was intended to complement CGI in hard-copy and batch operations. CGM has achieved the level of an ISO Draft International Standard. (Note: This is not for transfer of computer-aided design and drafting (CADD) data, which contains much more information than metafile data and is generally application dependent.)

GKS — Graphical Kernel System: This standard, which is an ISO standard that also has been approved by ANSI, is the main computer graphics programming standard. It describes formats for geometry and text in graphical files. However, it is nonhierarchical — each graphical object must explicitly be represented. The three-dimensional version will probably attain Draft International Standard status this summer.

IGES — Initial Graphics Exchange Specification: Translating data from one CADD system to another is difficult because representation formats are considered proprietary by the CADD system vendors. A neutral format — IGES — was developed to deal with this: Vendors need only provide translators from their proprietary formats into and out of IGES. File translations can then be effected by converting one system's file into IGES using the translator supplied by that vendor, then converting from IGES into the format of another system using the second system's IGES translator.

Almost all IGES postprocessors (translators out of IGES) work well. Many vendors, however, have produced poor preprocessors (translators into IGES) because they don't want to make it easy for customers to convert their data for use on other systems. Consequently, service bureaus have sprung up to meet the need for thorough data conversion.

In sum, IGES makes it possible to convert drawings from one CADD system to another, but it doesn't make it easy. For more information on IGES, contact the National Bureau of Standards, Building 220, Room A353, Gaithersburg, Md. 20899.

NAPLPS — North American Presentation Level Protocol Standard: Pictures are the subject of this standard, which is geared primarily toward videotext applications (a form of interactive remote computing) with relatively low resolution.

PHIGS — Programmers Hierarchical Interactive Graphics Standard: Another programming standard, it is designed to remedy the lack of hierarchy in GKS. Hierarchical structure means that instances of a graphical object can be used so that it is not necessary to represent each object explicitly.

— Joel Orr

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SPECIAL SECTION: CAD/CAM

Putting CAD/CAM Into Place

DAVE RIDLEY

BY PETER A. MARKS

Is computer-aided design/computer-aided manufacturing (CAD/CAM) a strategic issue? Should it command a significant share of corporate resources? There is, of course, no single answer that applies to all companies; these are, however, important questions for almost all companies to be asking. There are at least three reasons why company management should approach CAD/CAM from a strategic perspective. The first is that CAD/CAM is likely to represent a significant investment whether or not it is treated as a significant strategic issue.

The second reason is that many CAD/CAM investments will fail to provide any real strategic advantages. They may in fact be nothing more than the industrial equivalent of keeping up with the Joneses. For example, efforts to reduce drafting costs (which are usually less than 1% of total costs in a typical design and manufacturing company) may be good tactics, but they do not result in a strategic edge for most companies.

Third, several companies have been able to turn CAD/CAM capabilities into an important competitive advantage. These enterprises, including relatively small manufacturers as well as Fortune 100 firms, are outperforming their competitors largely because of their effective management of this technology. For these companies, there is little question that CAD/CAM is indeed a strategic issue.

In some respects, the implementation of CAD/CAM systems is much like the implementation of management information systems a decade or more ago. Many companies entered the promised land of MIS with great expectations and a long wish list of capabilities. Ten years later, many are still being buried under an avalanche of MIS information. Others, however, concentrated on critical needs and can today demonstrate that better control of key information has provided a strategic edge.

In the same way, too many companies are approaching an investment in CAD/CAM with great expectations and a wish list of capabilities in hand. The capabilities that these companies pursue are often driven more by the desires of functional managers to want the best possible tools; however, given the costs and importance of the CAD/CAM investment, more strategic direction is needed.

As a basis for understanding the strategic importance of CAD/CAM planning and management, it is helpful to view CAD/CAM as any useful combination of the following four technologies:

- Data base management.
- Computer graphics.
- Mathematical modeling (analysis).
- Data acquisition and control (physical prototypes, production processes).

For example, a typical turnkey CAD/CAM system (a system for which the supplier has complete responsibility for construction, installation and testing) includes a data base system to store and retrieve drawings and part attributes. It includes computer graphics for drawing, creation and display and it often contains companion programs for electrical or mechanical analysis (such as circuit simulation or finite-element analysis). Finally, a typical turnkey CAD/CAM system may be provided with programs to control production processes (such as numerical control or off-line robotic programming). Thus, it could include all four of the basic technologies. A material requirements planning program, as another example, is based primarily on only one of the basic technologies — data base management.

The important notion behind this four-part definition is that each of the four computer-aided technologies often represents an alternative approach for modeling and predicting the outcomes of various product decisions. Selecting the best overall combinations of problem-solving tools, computer-aided or otherwise, is an important tactical decision.

Strategy answers the question, "How should we allocate our resources?" In companies without a clear strategy, many people allocate corporate resources, but not in a coordinated manner. In such companies, you might find quality control managers identifying scrap and production managers shipping it, value engineers taking out product costs and design engineers putting costs back.

There is a direct relationship between strategy and the design function. Design activities have a significant effect on the allocation of a company's resources. Design affects decisions about the products a company chooses to make, how those products will respond to trade-offs between cost and performance, the costs of materials and manufacturing processes, ultimate product reliability and product life cycle costs. Therefore, although the typical manufacturing company allocates only about 5% of its resources to design and engineer its products, these activities have a tremendous impact on product price and performance. Once the product has been designed, about 80% of its ultimate costs and performance have already been determined. Clearly, the 5% spent on design and engineering can have tremendous leverage on competitive success.

CAD/CAM implementation, in turn, can have tremendous leverage on that 5%. Whether by freeing up additional time for engineering tasks, by helping examine more options or by conducting sophisticated simulations and evaluations, CAD/CAM investments can make engineers more effective.

Effectiveness is the key concept: the goal is not so much to reduce the 5% of costs spent in design and manufacturing engineering but to make better decisions about the 80% of product costs and performance that are determined by design and engineering.

This relationship between corporate strategy, product design and manufacturing engineering, and CAD/CAM may seem fairly obvious. However, most companies and vendors are still approaching the technology as if the primary goal were to reduce engineering costs rather than to improve product value and competitiveness. CAD/CAM systems can have an impact on design quality, but only if they are implemented with a clear set of strategic design objectives.

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> *CAD/CAM systems can make engineers more effective in a variety of ways. Effectiveness is the key concept; the goal of CAD/CAM is not so much to reduce the 5% of costs spent in design and manufacturing engineering, but to make better decisions about the 80% of product costs and performance that are determined by design and engineering.*

All things considered, the customer always tries to buy the best product. The key issue is that a company that does not incorporate into its product design an appropriate set of values is not likely to win many customers. (Included in product design are those decisions about materials and manufacturing processes which set the agenda for production.) Strategy determines an appropriate set of product values for each competitor. CAD/CAM, in turn, can help shape and improve product values in ways such as the following:

- **Faster response:** Companies that are currently losing orders because of extended delivery times are often able to win a larger market share by compressing the design and manufacturing cycle. For example, CAD/CAM has provided a competitive edge to companies involved in the manufacture of special machines and the design of high-technology products.

The use of CAD/CAM will not necessarily result in shorter development times unless the automated functions are on the critical path. If faster response is a strategic priority, a first step should be a detailed audit of the current development process. Depending on the organization, drafting may be a significant source of delays in one case, prototype testing in another case and product change notification process in yet another case. Once the critical functions have been identified, a CAD/CAM tool can probably be found to speed the process.

Automation of critical steps in the existing development process is a reasonably good beginning. Even better, however, is a fresh look at the entire process. For example, if product testing is on the critical path, computer-aided testing can help speed up this step. However, it could prove even more useful to reduce the amount of testing needed by early use of computer simulation significantly.

Making such a fundamental change in the existing product development organization can shorten the development process by months or even years. It is, however, a significant cultural transition for most companies. The organizational part of this transition may itself require several years. For this reason, it is often practical to automate parts of the current process in the short term, within the context of a longer-term plan. This will help to fundamentally reorganize development functions to make better use of CAD/CAM.

- **Greater design and manufacturing flexibility:** Production environments have traditionally been based on either batch production using general purpose machines or mass production using dedicated machines. Batch production allows considerable flexibility, but at the penalty of high per unit costs for such operations as setup, material handling and shop floor management. Mass production lowers per-unit costs, but only if production volumes warrant the initial investment and loss of flexibility.

With CAD/CAM and flexible manufacturing, companies can often provide a much better balance of custom-design performance benefits and mass-production cost benefits. In a traditional design and manufacturing environment, parts and model complexity tends to increase costs directly. When computers are used to manage this complexity, through the grouping of similar parts in data bases and the production of families of parts in flexible manufacturing systems, costs can be partially decoupled from complexity. A significant initial investment is still required, but the resulting design and manufacturing process can accommodate a wider range of similar parts. The benefits can include better satisfaction of customer performance needs, timely production and delivery, fewer design and production errors and lower inventory costs.

Those planning the use of these technologies, however, should keep in mind that advanced design and manufacturing methods will not revive obsolete product lines. Thus, a prerequisite for any investment in CAD/CAM for flexible manufacturing should be a serious attempt to anticipate customer requirements, applicable new technologies and competitive thrusts three or more years in the future.

- **Improved product cost or performance:** Product victories are often measured in fractions. A slight edge can mean major differences in market share and profitability. Companies that manufacture a narrow range of products in mass quantities can often afford significant investments in design to gain a slight competitive edge because the cost will be amortized over a large production volume. In some cases (such as the design of medical or military systems), costs may actually be unimportant relative to the desire for a slight competitive advantage.

CAD/CAM technologies can play a role in better understanding and optimization of product performance to gain that slight competitive edge. For example, solid modeling programs are becoming a highly effective tool for achieving improved fit, finish and appearance. Other related CAD/CAM applications can aid in the achievement of such objectives as reduced cost, lighter weight, simpler mechanisms, increased structural reliability and better user ergonomics.

It should be emphasized that the pursuit of a competitive edge, while potentially rewarding, can be difficult and costly even with computer aids. Furthermore, CAD/CAM systems and sophisticated analyses are not a substitute for good designers and engineers.

This means that companies must carefully choose those areas in which a competitive edge will make a difference to the customer and then provide workers with the best tools for the job. For an example of the difference a sharply focused strategy can make, compare General Motors Corp.'s X car and Chrysler Corp.'s K car. The cars are relatively comparable, and the companies had access to similar CAD/CAM technologies. GM had access to vastly superior resources: more money, more technology and more people. Chrysler, however, concentrated most of its resources on a few key product values: good appearance, good economy and the promise of reliability. Even with fewer available resources, Chrysler made the K car a relative success by seeking a competitive advantage where it mattered most.

- **Reduced need for physical prototypes:** Most companies design and build a product several times in order to gain the experience necessary to produce satisfactory results. Often, a few to several dozen physical prototypes are involved in this process. Many companies even let their customers do some product testing.

Products like buildings, bridges, satellites and heart pacemakers, however, need to be built correctly the first time. Other products, like automobiles and airplanes, are very expensive to prototype. The four basic CAD/CAM technologies can often be used to eliminate or reduce the need for traditional prototype testing. Data bases of past performance and best practices are one approach. Graphics simulation is another. More insightful testing of fewer prototypes, through computer-aided testing, is a third approach. Perhaps the most powerful approach, though, is mathematical simulation — building and analyzing a mathematical prototype in the computer.

Computer simulation can be much faster, cheaper and nearly as accurate as testing the actual product, and sometimes simulation is the only workable approach. For example, test conditions may be impractical to replicate in the lab (such as a hurricane or a nuclear power plant failure) or the product may be so costly to produce that it must be done correctly the first time. A related benefit is that simulation often forces engineers to understand the physics behind product performance. This design insight is much more valuable than trial-and-error prototyping.

Naturally, simulation is limited to problems that are understood well enough to be modeled mathematically. These problems include geometric interferences, mass properties, static and dynamic structural performance, kinematics, heat transfer, many fluids problems, most digital and analog circuit evaluation and many problems in process and inventory optimization. Because of the trends toward lower computing costs and the attention currently being given to simulation, new applications are continually being added.

When an effective simulation technique is to be applied to a key product performance concern, it is often beneficial to use both physical testing and mathematical analysis capabilities in tandem. The role of testing, however, will increasingly be to check assumptions about simulation inputs and modeling techniques. Such a partnership can be extremely effective in producing the product correctly on the first attempt or at least in reducing the time and cost of prototype testing.

- **Better performance at the leading edge:** Companies at the leading edge of a technology are often faced with no strategic alternative but to employ whatever tools are needed to design and build the next generation of products. The possibility is not so much for a slight competitive edge as for order-of-magnitude improvements. When such improvements are technically imaginable, the use of CAD/CAM technologies may be a prerequisite for success. The use of CAD/CAM systems for the manufacture and design of integrated circuits is an often-cited example. Other modeling technologies will probably prove essential in such diverse areas as controlled-fusion energy research, the design of ultraprecise machines, advanced structural applications for composite materials or even genetic engineering.

Performing at the leading edge is a high-risk, high-payback strategy that depends on the insight of key research and development people. One CAD/CAM implementation strategy is to conduct studies to determine probable sources of breakthroughs and then provide computer aids that might be essential for support.

- **More efficient use of scarce expert knowledge:** The availability of special skills and knowledge can be a limiting factor on growth or profitability. It is often feasible to leverage scarce knowledge resources either by improving experts' productivity or by incorporating experts' knowledge about best practices into computer systems.

The potential payback of eliminating or automating routine tasks can be high. The typical engineer spends only about two hours per day doing actual engineering. The rest of the time is spent on administrative tasks and trying to stay current on technology developments. While these functions are certainly a necessary part of the job, intelligent automation of the six hours of office routine each day can yield an extra hour or two for engineering or project management.

Productivity tools applied on an individual basis can typically provide two- or three-to-one efficiency gains for each automated task. The overall gain, because not all tasks will or can be automated, might be as much as 50%. While this is notable, sometimes much greater improvements are needed.

In such cases, the strategy may be to incorporate the expert's knowledge about best practices in a system others can use. The practical approach today is to employ existing CAD/CAM technologies, especially data base programs, to provide flexible access to information about best practices. Spreadsheets, for example, can be a good way of communicating information to distributors or sales engineers. A considerably more powerful approach is to link geometric information from a CAD or solid modeling system to a relational data base.

Regarding implementation, the effort required to create even a relatively simple data base of best practices is easy to underestimate. In general, however, the cost of establishing such data bases can easily be justified for key functions, as identified in the strategic business plan.

- **Directing the planning process:** Given the many opportunities that CAD/CAM presents, where should a company start in planning CAD/CAM investment? Like most questions about strategic planning, the answer involves both top-down and bottom-up components. In some enterprises, the top and bottom have yet to meet. For example, some top-management mandates to modernize and computerize have been barely able to budge the organizational inertia called resistance to change. Conversely, many research and development staffs and engineering departments have energetically pursued the state of the art, often without a good understanding or answer to the question of why.

Even in companies in which business and technical managers are not frustrated in their attempts to communicate, there is still often a missing element — the consumer. Any investment in CAD/CAM must ultimately be measured by the customer's willingness to buy one company's product rather than another's. Both general and technical managers can and should find common ground through a customer-oriented view of what each investment in CAD/CAM might provide.

Thus, the process for evaluating and planning for CAD/CAM from a strategic perspective should ideally start with a top-management mandate to develop a strategic profile of the business — to view its strengths, weaknesses and opportunities through the eyes of its customers. Such a profile is most useful when it is the joint product of the enterprise's key disciplines, including research, design, production, marketing, sales and finance.

Even if top management has abdicated its responsibility for technology management, product engineering and manufacturing managers should not take upper management's inaction as a license to avoid the issue. Many jobs can be performed better or faster with CAD/CAM tools; the key is to view the priorities through the customer's eyes. ■

Marks is managing director at Design Insight, a consulting firm specializing in the management of advanced technology for product development.

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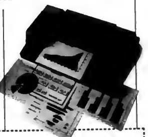

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MARKET ANALYSIS

Computer Vendors Reach For A New Market

• BY • NINA • G. • LYTTON •

The traditional computer vendors have the factory floor surrounded. They are omnipresent at the corporate planning and control level and in its interface to the manufacturing operation.

Over the last 20 years, computer vendors have refined their offerings in computer-aided design (CAD) and manufacturing planning and control and, as an adjunct to the latter, factory data collection equipment. Moreover, many computer vendors are suppliers of embedded controllers of shop floor equipment.

Putting computers on the factory floor is the logical next step toward fulfilling user needs to improve the effectiveness of the manufacturing operation and to integrate existing islands (or continents) of automation.

Major trends in the influx of computers into manufacturing proper are:

- Rethinking the utility of traditional approaches (for example, manufacturing resource planning, MRP II) in light of new approaches to improving manufacturing productivity (for example, Just-in-Time philosophy).
- Closer coupling of production planning and control systems with the factory floor, including the ability to integrate data acquired from shop floor devices.
- More workable interfaces between the design and manufacturing functions in both MRP II and materials requirements planning (MRP), insofar as bills of material are concerned and in machining applications.
- Intelligent windows onto the shop floor to help operating managers make better decisions and remedy problems more quickly.
- Computer tools further down the organization to support greater productivity of shop floor employees.
- Dedicated control of shop floor devices such as robots and materials handling equipment.
- Computer control of the manufacturing process itself.

The traditional computer vendors must respond to these trends or lose the franchise they have developed via their traditional MRP and CAD offerings.

The purpose of putting computers out on the factory floor is to support the work performed by the manufacturing organization directly. Unlike the office, which is a relatively uniform environment throughout all industries, there is no generic factory. Typical computer systems configurations are qualitatively different from industry to industry. Within industries, the optimal configuration varies from company to company. Even within a single company, the optimal configuration varies from plant to plant depending on age of the plant, existing layout, skill level of the work force and other site-specific factors.

The starting point for a discussion of computers in manufacturing is, then, to recognize the parallel between the logical organization of responsibility and the computer system that supports the work performed at each level of the organization. Such an analytical framework is general to all manufacturing operations, even though it obviously cannot describe a particular factory perfectly.

The Yankee Group believes the fundamental organizing principle in the manufacturing world is a hierarchical division of responsibilities. Within a manufacturing facility, the three fundamental levels of the hierarchy are defined by responsibility for the plant as a whole, a department and a work area.

Those responsible for the plant as a whole are, naturally, those responsible for maintaining the interface with the parent corporation. The lower levels of the organizational hierarchy are in direct contact with the shop floor.

The parallel of this organizational framework for the organization of computers in manufacturing is a six-level hierarchy. This article focuses on the levels of the hierarchy representing computers

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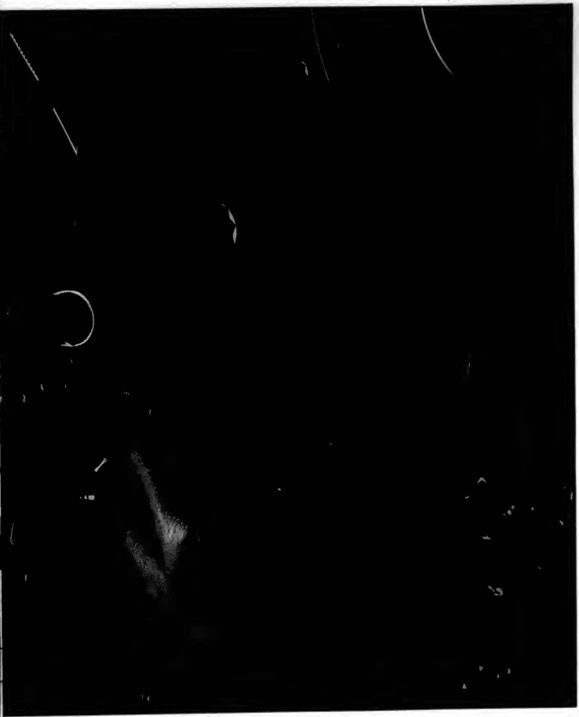
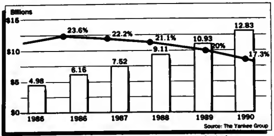


(as distinct from embedded intelligence) in manufacturing (as distinct from the organization as a whole).

Software running on plant-level computers coordinates the activities of the plant as a whole. The plant-level system provides the computing infrastructure for overall coordination of the activities of a manufacturing site.

The common element of supervisory applications is to monitor or control multiple work cells. Cell-level computers provide the computing infrastructure for monitoring or controlling multiple unit controllers. The difference between cell-level and supervisory-level computer implementations in an organization is one of scope and scale. The difference in computer functionality parallels the difference in organizational responsibility and the complexity of the tasks to be coordinated.

The major conceptual distinction is between planning and coordination and coordination alone. The supervisory-level computer supports decentralized decision making in the organization; the



Source: The Yankee Group

Figure 1. U.S. Market For Computers In Manufacturing

cell-level computer supports decision taking. The emergence of the cell level is an indication of the trend toward using computers to support lower levels of the organization.

As used here, the hierarchy of computers in manufacturing is a functional hierarchy. The scope of the functions is determined by the particular organization. The scope defined drives the number of supervisory and cell units and the particular processors used at each level. The implication of this statement is that the configuration of the hierarchy itself will vary with organizational demands. For example, in very large plants or complex manufacturing processes, there may be two supervisory levels in the hierarchy. In highly automated continuous process facilities, supervisory functions may be performed on the same computers that perform plant-level functions.

Managing information to support the work of the organization is the purpose of putting computers on the factory floor. However, the factory not only has terminals, workers and managers but also machine tools with computerized numerical controllers (CNC), robots, programmable controllers, microprocessor-based instruments and inspection stations and a growing list of other computer-based equipment.

The explosion of plant floor devices offers both opportunity and challenge. Intelligent plant floor devices do more than control mechanical processes. The opportunity lies in having, for the first time, the possibility of immediate capture of productivity, quality and efficiency data for every process controlled, monitored or inspected by one of these plant floor devices. No longer must companies rely on labor-intensive collection of information such as after-shift manual production counts and written record/keystroke data entry into business computers.

Using the intelligence embedded in and information generated by plant floor devices as part of a system to support the organization is the challenge of using computers in manufacturing. The implication for users is the need to recognize and evaluate the computer component and communications potential of intelligent devices and evaluate their synergy with the overall system requirement.

The use of computers at U.S. manufacturing sites is by no means uniform. The combination of different manufacturing situations, different benefits to be captured and different levels of available capital and human resources has led to widely different rates of adoption and absorption of new manufacturing technology between leaders and followers. As a result, the leaders are breaking ground for the use of technology as a means to regain manufacturing competitiveness. Followers are marching in the path cleared by the pioneers.

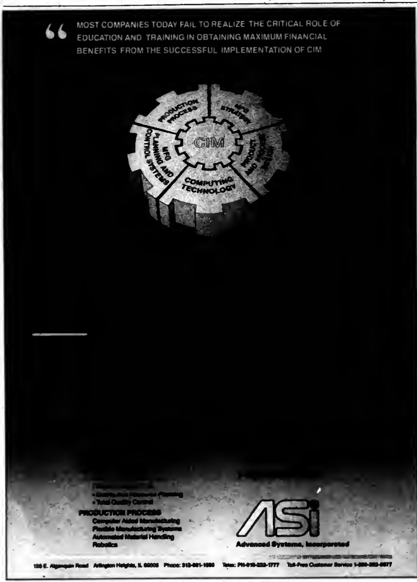
The Yankee Group's national survey of U.S. manufacturing sites reveals highly significant differences in penetration rates, installations, sophistication in judgement and in buying discrimination between large- and midsize manufacturing sites.

Large sites, as a group, are advanced users of computers and manufacturing technology. The core of the leaders is found primarily in a strictly defined demographic group — large manufacturing sites. Yankee Group data indicates large manufacturing sites present a good picture of a relatively sophisticated user community. Midsize manufacturing sites, by contrast, have as a group significantly less costly installations and dramatically lower spending plans for computers and other manufacturing technology.

The Yankee Group believes the market for computer hardware for use at manufacturing sites will be $4.98 billion for 1985 (see Figure 1). There are two major buying groups in the market. Large plant sites (2% of U.S. manufacturers) now account for 65% of total spending for manufacturing computers and will remain the largest market throughout the decade and midsize sites will be the growth market of the late 1980s.

Several forces are driving the market toward the $13 billion mark in 1990:

- Large sites will upgrade, augment or replace plant-level systems in the mid-1980s; medium-size sites will buy aggressively in the late 1980s.
- The supervisory level, the focus of integration efforts by large plants and the birthplace of islands of automation in midsize plants, will increase its share of



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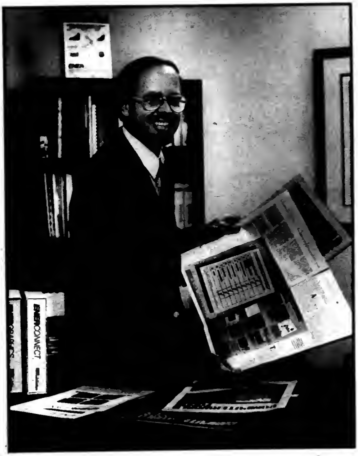

EnerConnect is the second major micro product from Enertronics, developers of the successful EnerGraphics package. As the ad for EnerConnect says, it is “. . . the first software package that puts mainframe graphics capability into the hands of anyone with an IBM PC . . . or 3270 PC.”

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the total market from 21% in 1985 to 34% in 1990.

- The cell-level computer market will expand throughout the decade as manufacturers provide computer tools further down the organization to support greater productivity of shop floor employees.

The traditional computer vendors will find the manufacturing computer market to be very different from the office market for the following reasons:

- More is demanded of computers in terms of ease of use, application development tools, communications, realtime performance and dependability under harsh environmental conditions.
- Microprocessor-based devices such as programmable controllers are computers in sheep's clothing, even though they may not be perceived as such by users nor sold as such by vendors.
- No factory nor set of business goals is alike; demanding users will require systems tailored to the needs of their organizations, while others will make do with interfacing commercial applications.
- Planning, purchasing and implementing manufacturing systems will involve more functional areas of the organization and higher levels of decision making than office systems.
- Most users will require at least some outside help in system definition or implementation because the higher the expectation, the more difficult it will be to plan and execute.
- The customization needs of the manufacturing market dictate that computer vendors focus on development of systems software or utilities. Most manufacturing applications software will be provided by third parties and will become increasingly specialized to industry needs.
- The growing class of hardware resellers including system integrators, software OEMs or consultants will become increasingly important in the market, and marketing through such intermediaries will be mandatory for vendors of computers in manufacturing.

IBM and Digital Equipment Corp. are the major rivals for dominance of the computer component of manufacturing systems. The trend toward increasing integration of the manufacturing process gives the traditional rivalry between IBM and DEC a new twist.

According to a study just published by the Yankee Group, IBM will (through its direct and third-party marketing channels) rack up 46% of the total U.S. market for computers at manufacturing facilities. Through all channels, DEC will rank second with more than 22% of the total market. Yet, according to Yankee Group's *Computers in Manufacturing: The Traditional Computer Vendors*, the overall results mask a horse race in the high end of the market.

While IBM is first in the market for large computers running plantwide applications, the company is a runner up in the market for supervisory-level computers that coordinate multiple work cells. DEC's position is the reverse: number one at the supervisory level, DEC wants to gain share in the larger plant-level computer market.

DEC seems to have made greater inroads onto IBM's prime turf than IBM has onto DEC's. DEC may be capturing the U.S. automation leaders at large manufacturing sites. (The Yankee Group estimated plants with more than 500 employees accounted for 65% of the total manufacturing computer dollars in 1985.)

Findings indicate that DEC's franchise is in large manufacturing sites. DEC has a stronger position among large users both on its traditional supervisory-level turf and at the plant level than it does overall. IBM has not made as great inroads at the supervisory level at large user sites as it has in the market overall.

In any market, DEC's most enduring strengths are the family compatibility and networking capability of its VAX line. In the manufacturing computer market, these selling points play directly to what Yankee Group data indicates is the number one integration priority of most manufacturers: moving data between shop floor systems and production planning and control systems running on the plant host.

While DEC may erode, it will not walk away with IBM's traditional market at the plant level. IBM's dominant position in plant-level computers means that the majority of users and third-party software developers will stick with IBM.

Further, changing purchasing patterns are working in IBM's favor. Formulating manufacturing technology strategy requires participation across the operating units from many functional areas of a corporation. This means that many long-standing IBM customers in the MIS and CAD organizations are increasingly becoming involved in the manufacturing computer purchase decision. As organizational involvement broadens, the decision-making process moves up the management ladder. IBM has a long history of selling to the top corporate echelon, whereas DEC is just learning the ropes.

Finally, IBM is expected to become more competitive on DEC's prime turf. Recently, the Yankee Group has observed some large manufacturing sites choosing the Tandem over the VAX, citing the former's transaction processing speed, partioned data base and fault-tolerant features. With the System 88 (the Stratus), IBM has still another card in its hand to play against DEC at the supervisory level.

Lytton is an industry analyst with the Yankee Group's Manufacturing Automation Planning Service (MAPS). The Yankee Group is a Boston-based market research and analysis firm serving users and vendors of communications technologies.

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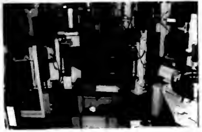

• BY • STAN • KOLODZIEJ •

The Black & Decker Corporation is on track toward its goal of becoming a global manufacturing company through a strategy of integrating computers and manufacturing processes. The diversified company based in Towson, Md., in many ways is already global, operating manufacturing facilities in England, Continental Europe, Singapore, Brazil, Mexico and Canada. These countries have operated autonomously in the past, producing products geared to the variations in regional markets and installing their own manufacturing systems and computers.

This has worked admirably, but it has produced some inefficiencies the company intends to remedy with its concept of globalization.

The ball started rolling with the formation of a Black & Decker CIM (Computer-Integrated Manufacturing) Steering Committee in 1982, made up of the Black & Decker heads of manufacturing in North America. Phase One of the committee's study was completed in the summer of 1983.

"By the time of the study, our concept of CIM had really expanded," explained Al Wordsworth, corporate vice-president, manufacturing systems. "We had taken it from perhaps a little computer-aided design (CAD) and some machine tools to a corporate philosophy embracing the development, manufacturing, distribution and service processes. CIM became a Black & Decker strategy."

In January 1984, the CIM committee completed its study, and set forth a program listing nine major CIM categories and including 23 major projects. From the list of major projects, the Manufacturing Planning Control System (MPCS) project was given high priority. A North American MPCS subcommittee was formed with Al Wordsworth in charge.

"Members of the subcommittee were primarily users, materials managers from various manufacturing facilities," Wordsworth explained, "with support from our own Information Systems group. Our initial challenge was to define the future manufacturing environment for Black & Decker — what it was going to be like five or 10 years down the road."

Forces were already working within the company, according to Wordsworth, that were helping to shape that direction. "There had already been a lot of activity between the various manufacturing operations," he said, "and systems support people had been requested to modify and supplement our systems because our modes of operation were changing."

In the past, Wordsworth said, most of Black & Decker's production had been operated on a job shop basis. Since about 1982, the company, however, had also been making the transition to a Just-in-Time type of manufacturing environment or a mixed environment whereby a facility might be 80% Just-in-Time production and 20% job shop operations.

"Just In Time was an interesting process in itself," Wordsworth explained. "Back then, there was very little information on it. We had to dig. We started a pilot project at our Fayettesville, N.C., plant to test the Just-in-Time theory and generate some enthusiasm at the grass roots level. The plant is probably now about 85% repetitive manufacturing which means that 85% of the catalog numbers built in that plant are produced on a weekly basis."

At the same time, Wordsworth said, Just In Time was being implemented in other plants. "Then, because of the communications, Just In Time began to spread everywhere. Plants in Europe followed. The majority of Black & Decker plants are now at least in some phase of repetitive manufacturing."

The push to Just In Time was also placing a strain on existing manufacturing software that had been developed in-house in the 1960s and 1970s. "It was a very sophisticated system," Wordsworth explained, "and was a strategic weapon for us because we did well in terms of managing our business and inventories. But things were changing and most manufacturing operations required a week in the planning cycle. We were doing some planning on an hourly basis in some cases or issuing orders twice a day, so we were developing little subsystems to try and support that. It was getting pretty cumbersome and the users indicated it was chewing up a lot of computer time."

Wordsworth added that the impetus from the operational people helped support the effort because their input was taken to the MPCS subcommittee. The group realized that the in-house system was too archaic and could not be modified to do what Wordsworth and the others wanted to do.

"Besides," Wordsworth said, "we didn't want to be in the software business. Our business is to build and sell products."

After defining the future Just-in-Time environment, the MPCS committee developed a document that defined what would be required from a systems point of view.

"This was, at the time, a North American document, and from all the functional areas it bumped up against purchasing, engineering and finance in the plants," Wordsworth explained. "They all got their licks in as to what this system had to do to support this new environment.

"In the summer of 1984, we had the first global meeting of the MPCS," Wordsworth said. "We had included in that meeting for the first time the new General Electric Co. product group acquisitions Black & Decker had made. So we now brought into the fold representatives from the GE plants and our European plants. We took what had been the document on North American requirements, got input from the Europeans and incorporated them into a set of global requirements."

Corporate MIS selected IBM as the hardware vendor on which to standardize globally, then went looking for a software vendor.

"Again, we said we just couldn't modify the in-house software," Wordsworth explained, "so we decided to see what kind of packaged software we could find. We looked at 52 vendors and shortlisted quickly to four or five, based on compatibility with the hardware, with our data base software and availability of the manufacturing modules we wanted. By late summer 1984 it was down to two vendors.

"We had their people come in and make presentations with the MPCS group, we visited some of their customers and had both of them give hands-on demonstrations in our Spennymoor, England plant. Another test was to respond in writing to our set of requirements to see how close a match we could get."

Black & Decker's Information Systems people were heavily involved, counseling on software selection and other matters. By early 1985, the company had decided to go with Management Science America, Inc. (MSA) as their software vendor.

"By our estimates," Wordsworth said, "both software finalists had about 70% of our requirements. MSA, however, could talk manufacturing and they had global support — and this is a global project."

In July 1985, the MPCS committee took its budget proposal to the Black & Decker

> ”
>
> *'Our initial challenge was to define the future manufacturing environment for Black & Decker — what it was going to be like five or 10 years down the road.'*
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board of directors and it was approved.

"I can't stress the importance of this top corporate support," Wordsworth said. "The current health of the MPCS project and CIM in general is a direct result of our top management support and their determination to take us from a multidomestic [independent operating units in each country] to a global firm."

Indeed, Black & Decker's MPCS will be one of the prime vehicles in the company's push to derive long-term benefits from global standardization, As the natural boundaries between the company's products fade, standardization across the board is making sense. Wordsworth and the others in the MPCS committee will put in place global commodity coding methods, part numbering methods, charting of accounts, catalog numbers and product costing methods and other global coding and classification methods.

"Just getting everyone on such standardized methodology will take about three years," Wordsworth explained. "In the end it's going to make for faster production cycles, lower product costs and will lessen materials handling."

Wordsworth explained that such standardization will enable someone sitting at a terminal in North Carolina to inquire about the status of certain parts they are getting from a plant in France. "Or if they are buying parts from Brazil or Maryland they can load those requirements at a terminal at that location. The software will be absolutely compatible."

"The concept behind this project," explained Gerald Townsend, director of data administration at Black & Decker, "is to simplify the inside of the factory to get rid of much of the existing overhead structure, at the same time standardizing the way to do the manufacturing planning and control processes. This would include implementing standard costing systems, purchasing procedures, standard master production scheduling, capacity planning and so on. That's the context of MPCS.

"These are the things that will make us grow synergies. But we are not trying to fit a round factory into a square hole. We are not trying to say to our manufacturing and engineering community that they are all the same. What we are saying is that if our global operations do 100 things, 80 of them may be done whatever way the local culture dictates, but 20 of them must be done the same."

Townsend said the aim is to create a highly-repetitive manufacturing environment whereby "Black & Decker suppliers are given visibility into our schedules and delivering material to our factory floor, not to our warehouses. There we want to be able, at the end of our assembly line, to take off a finished product, flush the cost back into a manufacturing accounting system and pay the vendors based on what's finished, not what's delivered."

MPCS, as mentioned, is just one of the large projects on the slate at Black & Decker. Townsend said other projects include three in Information Systems dealing with standard ways to manage data, three or four projects dealing with product quality and several others dealing with other areas of CIM, including shop floor control. Eventually all of these will tie together.

"Out of the CIM project, for example, came a concept called design for assembly," Townsend explained. "The concept says that you try and design a product cutting down on the number of parts so you begin to look at the design differently. Things become modular; they can snap together. Instead of 60 parts you might bring it down to 20 or 25 and the whole thing can be automated with a pick and place robot. All this can be tied into our CADAM design data base and can shorten the design cycle dramatically.

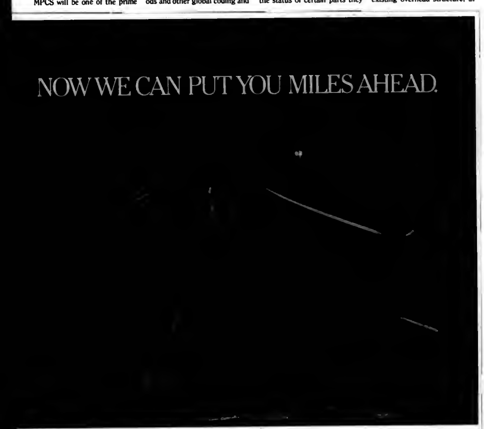
"We expect new part designs to be down as much as 40% or 50% when this system is in place."

MPCS is currently being pilot tested at Black & Decker's Spennymoor factory in England. The plan is to implement pilot software in England beginning in 1986, finishing in the U.S. and other countries by 1988.

Overall, Townsend said the MPCS project is the biggest of its kind that Black & Decker has undertaken in any of its functional areas.

"And remember, CIM sits on top of this," he added. "The scope is truly global."

Kolodziej is a senior writer at Computerworld Focus.



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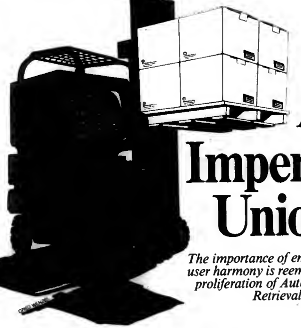


An Imperfect Union?

The importance of ensuring MIS and end-user harmony is reemerging along with the proliferation of Automated Storage and Retrieval Systems.

• BY • LEE • WHITE •

Just when the war between MIS and end users seemed to be over, with members of far-flung departments communicating with each other and with data processing professionals in the jargon of bits and bytes, it seems the battle for computer supremacy on the shop floor is just heating up.

MIS involvement was difficult to exclude in manufacturing resource planning (MRP II) because MRP II runs on the company mainframe. And most manufacturing professionals who wanted to be masters of their own applications had to go first through MIS to get their personal computers and then through the information centers for basic training. But many manufacturing diehards seem intent on excluding MIS from the ranks whenever possible, and this has certainly been the case with the installation of automated storage and retrieval systems (ASRS).

ASRS is one of the newest of the technologically advanced projects to hit the factory floor. Although some ASRS facilities have been in operation since the 1960s, interest has been spurred in the past five years primarily because the facilities lend themselves well to MRP II and Just-in-Time manufacturing techniques.

At first glance, ASRS appears to be a pure manufacturing project — a neat segue from the older manually tended racks of parts and finished goods. In reality, though, the easy metamorphosis exists only in concept. Of paramount importance is the interface between the minicomputer that controls the ASRS and the mainframe that stores information needed by members of the accounts payable and receivable departments, cost accounting, order processing and, if an incentive pay system is used, the payroll department. And the key to this interface is the MIS department.

An ASRS is often a separate building, but the word building is used loosely. Actually, while the facility looks from the outside like a building without windows, the inside is really a multistoried machine. Controlled by computer, this machine is made up of conveyors and racks. Parts and finished goods are stored in a random manner, very much like bytes on a floppy disk, and retrieved when needed.

While one of the reasons manufacturing companies decide to install an ASRS is its space-saving ability, two other reasons make ASRS an economically feasible project. One of these is the fact that because parts and/or finished goods are immediately available, inventories can be kept small — and low inventories are the primary goal of Just In Time. The other reason may affect bottom-line profitability even more: Because ASRS is a machine, it can be amortized over a shorter period of time than the 15-plus years necessary to amortize the cost of a new building.

Management at Whirlpool Corp.'s Worldwide Service Parts Distribution Center in LaPorte, Ind., realized in 1972 that major plant expansion was needed. Planning began immediately to build an ASRS, and the committee included members of all appropriate departments, including MIS. The project was completed in 1975 and has been running well ever since.

Robert Lamb, equipment engineer at Whirlpool, called the project "very successful" and ascribed part of the success to Whirlpool's MIS involvement, particularly because they elected to do their own inventory control and location assignments on the mainframe prior to the ASRS installation. "MIS involvement was required because they handled the programming for the inventory, management of the inventory and the assignment of locations within the rack system," he explained.

Lamb doubts that MIS is involved in the day-to-day ASRS operations, except for routine maintenance. However, the company is looking to upgrade its interface between the material handling computer and the mainframe, and MIS will again play an important role in that upgrade. Lamb is sure that the smoothness that characterized the initial implementation will hold true for the upgrade because there is a close working relationship between manufacturing and MIS. "We're all on the same team," Lamb said.

Unfortunately, the success story at Whirlpool was not echoed by others interviewed by *Computerworld Focus*. An MIS executive at a Fortune 500 company in New York described the history behind his company's ASRS implementation as full of "political undercurrents" that "probably contributed to the minimal amount of MIS involvement," adding that "it's certainly not the normal way of doing business."

This particular executive who asked not to be identified because "things are still in the mill and all the players are still present," thinks that MIS should be involved from the beginning and that the planning and implementation should be a team effort.

But he takes the issue of MIS involvement one step further. "I believe the responsibility should go to the ones who have the better chance of success. If manufacturing has its own group of people who have the expertise then fine, let them do it. On the other hand, if they don't have that expertise, then it's a no-win situation from the word go," he explained.

The MIS executive said the test will come with the interface between the ASRS Digital Equipment Corp. PDP 11/44 and the company's IBM 4381 mainframe. The manufacturing-defined interface is minimal, but because more of the expertise exists in the MIS department, the executive thinks that MIS should be running the project. "It sounds like the 'not-invented-here' syndrome or sour grapes, but it's not that at all. But the politics are such that even if it doesn't work right, as long as you can hide that from the rest of the world, you're golden. It all depends on how good a job you can do to create the illusion that the thing is successful. You can fool some of the people some of the time. . . .You know how that saying goes," he concluded.

The New York case is not an isolated one. In 1978, Worcester, Mass.-based Wright Line, Inc. hired a materials handling consulting firm to help develop the size, throughput and MRP II interface specifications for an ASRS. The in-house committee was headed by a manufacturing engineer and included representatives from methods and tooling, production engineering, systems, cost accounting and corporate audit plus the production manager and materials manager.

Don Weymouth is presently director of manufacturing and distribution operations strategy at Carlisle Engineering in Carlisle, Mass. In 1978, Weymouth was manager of manufacturing systems at Wright Line and for the ASRS project he was charged with the software portion and the interface to the MRP II system.

Weymouth thinks that the systems people should have been involved more and earlier. In November 1979 the functional system design, including how the ASRS computer would interface with the mainframe, was finalized.

"And this [how it was going to interface with the mainframe] is where we made a tactical error — with an MRP system it had to get information constantly. Because of the fear from the systems people's point of view of the interface between an IBM [4300 series] and a DEC [PDP 11/34] machine, not to this day do they have real good communications between the two," Weymouth said.

As a result of the fear factor, data from the IBM mainframe was downloaded to tape and uploaded to the DEC computer. Then someone rekeyed all the data including part numbers and quantities. According to Weymouth, only recently has the IBM mainframe given the file to the DEC computer. "There was no reason why they even needed to [dump the tapes]. [The interface] should have been done immediately," Weymouth said.

In retrospect, Weymouth said there were a number of things that should have been done differently. The ASRS was meant to be a turnkey operation, but "nobody had any idea [the ASRS] was as much an integral part of the business as it was. Many things were done because it seemed efficient at the time. It turned out that it was very difficult to get the interface later on," he said.

One of the changes Weymouth would make if he had a second chance would be to make the ASRS facility itself a quarter of the size. The beauty of an ASRS is its efficiency because factory runs can be twice as long and double the number in half the time.

"People didn't realize that it takes money to put the material in, handle it, store the information and communicate back to control the inventory. ASRS should have been used to cut the inventory because you could get the information immediately. Instead, they filled [the ASRS] up. That was the last thing it was meant to do," Weymouth explained.

But of more importance, added Weymouth, is the interface with the mainframe. "I would interface immediately and we would make it work," he insisted, adding that the systems professionals would go along with the interface if they could be assured that the inventory that was in the ASRS was accounted for accurately in the mainframe.

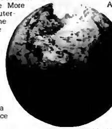
But retrospect and hindsight are not of great help when a multimillion dollar project does not achieve the expected degree of success. Most companies that undertake a massive project like ASRS have little experience and rely to a great extent on vendors and consultants. Vendors often do their customers a disservice by not warning them of the pitfalls.

Weymouth sees vendors' attitudes changing. "Material handling vendors have turned more into systems integrators. They now know the technology they have to communicate with, whether it is hardware or software. Before they made the hardware work and let you worry about it from there."

However, most companies don't go through an ASRS installation more than once, and knowing that others have also suffered the slings and arrows of outrageous fortune is little consolation to those who have been involved in an unsuccessful ASRS implementation.

Perhaps MIS directors and manufacturing engineers contemplating an ASRS might benefit from an observation of Whirlpool's Lamb: "I have seen [ASRS] installations where the implementation was done and they didn't have the inventory control package ready. They're keeping their inventory in a shoebox!" F

White is a senior writer at Computerworld Focus.



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DEC Unveils Technical Workstation

DEC's Vaxstation 11/GPX

MARLBORO, Mass. — Digital Equipment Corp. has announced its first technical workstation for the Unix marketplace.

The new workstation called the Vaxstation II/GPX is based on the Microvax II computer and a new very large-scale integration (VLSI) graphics coprocessor that provides high-performance color capabilities. While the initial offering uses the Ultrix operating system, the workstation also supports VMS.

The Vaxstation II/GPX VLSI graphics coprocessor implements a range of display functions including fast image copy and vector drawing; pattern fill, clipping, scaling and zoom; and scrolling. The chip operates at speeds up to 560M bit/sec. All operations are performed in parallel on all planes resulting in equal performance for eight-plane and four-plane systems.

In addition, the new workstation features the X-Window System that allows network-transparent windowing and graphics access; networking support including Decnet, TCP/IP and Ethernet; and gateways to allow users to communicate with Systems Network Architecture and X.25 systems.

DEC has also introduced three new 32-bit, VAX-based computer systems, the midrange VAX 8300 and VAX 8200, and the VAX 8800, DEC's most powerful system to date.

The VAX 8800 has dual processors that share 32M bytes of main memory, each processor having 64K bytes of cache memory and an integral floating point accelerator. The company said the high-end VAX system uses a new 60M-byte/sec memory interconnect for processor/memory transfers and as many as four new VAXBI (VAX bus interconnect) busses for up to 30M bytes/sec input/output transfers.

DEC said its VAX 8300 is a dual-processor system with 12M bytes of main memory and is designed for computer-intensive applications such as simulation, image processing and computer-aided design. The VAX 8200 is a single-processor system with 4M bytes of main memory.

The VAX 8800 is priced at $650,000 while the VAX 8300 and VAX 8200 are priced at $122,000 and $79,000 respectively.

The Vaxstation II/GPX is offered in four configurations: the Entry-Level Color System is priced at $35,000, the 8-Plane Color System at $39,950, the Extended Color System is $53,800 and the Gray Scale System at $33,000.

For more information, contact Digital Equipment Corp., Maynard, Mass. 01754.

Circle Reader Service Number 229

Concord Data Systems Introduces Integrated Hardware/Software Solution

WALTHAM, Mass. — Concord Data Systems, Inc. has introduced Mapserver/Plus TIM, an integrated hardware/software solution that provides high-speed Manufacturing Automation Protocol (MAP) connections and RS-232 terminal networking capabilities over broadband and carrierband IEEE 802.4/MAP networks.

Mapserver/Plus is based on Concord Data Systems four-port Token/NET Interface Module (TIM) hardware and is available for 5M- and 10M-bit/sec broadband networks and 5M-bit/sec carrierband networks.

The product includes both MAP and terminal networking software. The MAP interface operates over a high-speed, serial RS-449 data link at speeds up to 56K bit/sec. The Terminal Server Software provides synchronous and asynchronous terminal support over three RS-232 serial ports. The software is a full implementation of the International Standard Organization's model for Open Systems Interconnection and extends the current MAP specification to include terminal and networking capabilities.

Concord Data Systems has also introduced Mapware, a set of hardware and software products aimed at systems integrators and original equipment manufacturers (OEMs).

The MAP Interface Board is a communications controller that fits into the backplane of a programmable device or computer. The company said the Interface Board uses a VLSI chip set that directly implements all the IEEE 802.4 requirements, is designed to accommodate a variety of backplanes and can be used with both broadband and carrierband modems.

The company said that Mapware software supports all seven layers of the MAP 2.1 specification, including the IEEE 802.2 Class 1 Logical Link Control and Class 3 Immediate Response Option Driver, the International Standards Organization (ISO) Connectionless Internet Protocol and the ISO Session Kernel. The Mapware Software is included with each MAP Interface Board and provides user interfaces into ISO layers two through seven.

Concord Data Systems has also introduced 10 MBPS and 5 MBPS carrierband and broadband modems priced at $700 and $1,150 each, respectively.

The MAP Interface Board (without modem), MAP interface Board with carrierband modem and MAP Interface Board with broadband modem are priced at $2,500, $2,850 and $3,500 respectively.

Mapserver/Plus TIM is available in three versions: 5M-bit/sec broadband at $4,870, 10M-bit/sec broadband at $5,845 and 5M-bit/sec carrierband at $4,500. The 5M-bit/sec broadband version is available immediately; the 10M-bit/sec broadband and 5M-bit/sec carrierband will be available in June 1986.

For more information, contact Concord Data Systems, Inc., 303 Bear Hill Road, Waltham, Mass. 02154.

Circle Reader Service Number 230

MAP Link Debuts

MARLBORO, Mass. — Stratus Computer, Inc. has announced Manufacturing Automation Protocol (MAP) communications support software that allows applications running on the company's fault tolerant computers to communicate with dissimilar computer devices in a factory environment. According to the company, the software provides fault tolerant application program interface to factory environments, complies with the MAP 2.1 specification, interfaces through standard Stratus Computer communication controllers to a MAP IEEE 802.4 broadband network bus interface unit and facilitates the modification, expansion and maintenance of information facilities in a structured, integrated manner.

The Stratus Computer MAP software costs $10,000 per module.

Contact Stratus Computer, Inc., 55 Fairbanks Blvd., Marlboro, Mass. 01752.

Circle Reader Service Number 231

Cadtrack Corp. Offers CAD

SUNNYVALE, Calif. — Cadtrack Corp. has introduced a computer-aided design software package for designers of new and retrofitted processing and power plants.

According to the vendor, Plant-Trak supports the full range of plant design functions, from flow-sheets to three-dimensional modeling and drawing production through construction management and daily plant operations. The software package runs on an IBM Personal Computer XT or Personal Computer AT with 640K bytes random-access memory, a monochrome monitor and one enhanced graphics monitor.

In addition, Plant-Trak stores three-dimensional models of large plant volumes on disk as well as complete ANSI piping and AISC steel catalogs for the designer and retrofitter. Graphic reports such as fabrication isometric drawings are produced automatically from the plant model. Plant-Trak also features an English-language data base query system.

Plant-Trak is presently priced at $15,000.

For further information, contact Cadtrak Corp., 823 Kifer Road, Sunnyvale, Calif. 94086.

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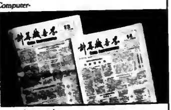

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PRODUCTS

IBM Adds To 3090 Line

RYE BROOK, N.Y. — IBM recently announced two entry-level uniprocessors for the 3090 series computers, a twofold increase in expanded storage for other 3090 models and four replacement processors for its 4381 line.

The company also announced price cuts: 3090 series prices were reduced from $5 million to $4.5 million for the model 200 and from $9.3 million to $8.5 million for the model 400; prices of the 3080 processors were reduced by up to 21%.

The two uniprocessors, model 150 and model 180, use the same technology as the larger 3090 models. The 150 can be converted to the 180 and the 180 to the 200 at a customer's location. The model 150 has 32M bytes of central storage that can be increased to 64M bytes and 16 high-speed input/output channels, to which an additional eight can be added. Storage on the 180 can be expanded to a maximum of 256M bytes and input/output channels can be increased to 32. An IBM 3090 Vector Facility can be attached to the 150 and 180 for improved engineering/scientific performance. The IBM 3090 model 150 with 32M bytes of central storage and 16 channels costs $1.7 million, while the 3090 model 180 with 32M bytes of central storage costs $2.6 million. The cost of adding a vector facility to either model is $370,000, while the charge for upgrading a model 150 to a model 180 is $900,000 and from a 180 to a 200 is $1.9 million. Model 180 will be available in April and model 150 in October.

The new models of 4381 processors, including the entry-level Group 11, two intermediate-level Group 12 and 13 and the high-end Group 14 dual processor replace the current family of 4381 processors that IBM has withdrawn, effective immediately. IBM also announced that the 4341 processor line is being withdrawn effective May 12. Current 4381 installations can be converted to the new models in six to 14 hours, according to the vendor, and users of the new 4381 processors can convert their installations to any larger model in the 4381 line. IBM said the new models provide up to a fivefold increase in computing power, double that of the current family.

Prices for the new 4381 processors are $185,000 for a Model Group 11 with 4M bytes of memory, $330,000 for a Model Group 12 and $440,000 for a Model Group 13, each with 8M bytes of memory and $735,000 for a Model Group 14 with 16M bytes of memory.

For further information about these products, contact IBM, 900 King St., Rye Brook, N.Y. 10573.

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NSC's New Line

MINNEAPOLIS — A line of Hyperchannel B series communications products for networking workstations, mainframes and personal computers has been introduced by Network Systems Corp. (NSC).

Among the new B series products are the BC222 adapter that connects to the IBM 4300, 3080 and 3090 series mainframes, the BC110 adapter that connects to Control Data Corp. Cyber 70, 170, 700 and 800 series mainframes, the BC403 adapter that connects up to four minis through a coprocessor board or other NSC interface board and the PC Dataport P1270 and P1370 coprocessor boards that allow an IBM PC or PC XT to function concurrently in any one of three modes: 3270 terminal emulation, ASCII terminal emulation or full computer operation.

The BC110 and BC222 adapters are priced at $20,000, the four-port BC403 is $9,600 and the PC Dataport P1370 and P1270 coprocessor boards are $1,295 and $995, respectively.

Contact Network Systems Corp., 7600 Boone Ave. N., Minneapolis, Minn. 55428.

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Gerber/MCS Unveil Workstation

SOUTH WINDSOR, Conn. — The Sabre-PC, a desktop workstation based on Cadkey software made by Micro Control Systems (MCS) of Vernon, Conn., was recently unveiled by Gerber Systems Technology, Inc. Gerber and MCS announced that they would market the products and work together to make the product fully compatible with Gerber's Sabre-5000 computer, a 32-bit design system based on the Unix operating system.

According to the vendor, the three-dimensional IBM Personal Computer-based system fulfills the first phase of its plans to provide complete computer-integrated manufacturing systems to automate the factory. The Sabre-PC system allows each design and manufacturing task to be sized and located appropriately throughout a facility.

The Sabre-PC is priced at approximately $20,000.

For more information, contact Gerber Systems Technology, Inc., 40 Gerber Road E., S. Windsor, Conn. 06074.

Circle Reader Service Number 235

W.I.P. FAT.

HOW TO WHIP IT, FROM THE LEADER IN ON-LINE TRANSACTION PROCESSING.

CIRCLE READER SERVICE NUMBER 123

Sun Microsystems Announces Workstation And Processor

MOUNTAIN VIEW, Calif. — Sun Microsystems, Inc. has announced the Sun 3/50M Unix workstation, a 32-bit machine with 4M bytes of main memory expandable to 16M bytes and processing speeds of up to 1.5 million instructions/sec.

The Sun 3/50M is based on a Motorola Corp. 68020 processor and includes an Ethernet controller, two serial ports, small computer systems interface, mass storage host adapter and ports for a keyboard and mouse. Sun's 19-in. monochrome display is 900 by 1,152 pixels.

Also introduced was a hard disk version called the Sun 3/52M, equipped with a 71M-byte hard disk and a 60M-byte, ¼-in. cartridge backup tape.

The Sun 3/50M is priced at $7,900; the Sun 3/52M is $13,900.

For further information, contact Sun Microsystems, Inc., 2550 Garcia Ave., Mountain View, Calif. 94043.

Circle Reader Service Number 236

Allen-Bradley's Vista Lan/PC Connection Bridges Networks

Allen-Bradley Co. Vista Lan/PC

CLEVELAND — The Allen-Bradley Co. has announced a personal computer-to-local-area network connection called the Vista Lan/PC, which plugs into the accessory slot of IBM or IBM-compatible personal computers.

The company said the connection works by means of a circuit card that plugs into the accessory slot. The card has cable access control and handles token passing and packet-formating tasks for the personal computer on the broadband network. Up to five broadband channels can be used with the card, and the Vista Lan/PC communications software is loaded into the PC and works with standard PC-DOS or MS-DOS software for networking.

Another feature, the company said, is its bridging capability, the tying together of many current baseband PC file server or print server networks to the broadband network. When existing networks are bridged through Vista Lan/PC, they retain their own protocol and message formatting characteristics.

The Vista Lan/PC circuit card is priced at $650. For more information, contact Allen-Bradley Co., 747 Alpha Drive, Cleveland, Ohio 44143.

Circle Reader Service Number 237

Hewlett-Packard Offers Controller

PALO ALTO, Calif. — Hewlett-Packard Co. has announced the HP 97503B, a 20M-byte, 3½-in. Winchester disk drive mechanism and controller targeted at the industrial original equipment manufacturer (OEM) market.

A spokesman from the company said the HP 97503B features an electronic feedback system that measures servo information written between each data sector, permitting the drive to read and write data accurately.

The company added that the HP 97503B works on the factory floor in almost any industrial application, with the seal on every unit pressure tested to prevent contamination of the head/disk assembly.

In addition, a particle trap and chemical corrosion filter strengthen the mechanism's ability to stand up under harsh conditions.

The HP 97503B is priced at $1,250 for single units.

For more information, contact Hewlett-Packard Co., 3000 Hanover St., Palo Alto, Calif. 94304.

Circle Reader Service Number 238

Hewlett-Packard Co. HP 97503B

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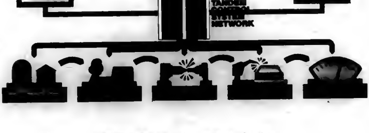

Tandem controls shop floor, integrates planning.

CALENDAR

March 20-21, San Francisco — **T1 Networking and Bypass.** Contact: Business Communications Review, 950 York Road, Hinsdale, Ill. 60521.

March 24-25, Chicago — **Integrating Voice and Data in the PBX.** Contact: Business Communications Review, 950 York Road, Hinsdale, Ill. 60521.

March 24-26, Houston — **Office Automation Conference.** Contact: American Federation of Information Processing Societies, Inc., 1899 Preston White Drive, Reston, Va. 22091.

March 24-27, Atlanta — **Interface '86.** Contact: Interface '86, 300 First Ave., Needham, Mass. 02194.

April 1-3, New York — **Understanding Modern PBX Systems.** Also April 15-17, Chicago. Contact: Business Communications Review, 950 York Road, Hinsdale, Ill. 60521.

April 2-3, Chicago — **Introduction to Telecommunications Systems: Technologies and Applications.** Contact: Business Communications Review, 950 York Road, Hinsdale, Ill. 60521.

April 2-4, Washington, D.C. — **Introduction to Data Communications.** Also, April 14-16, Atlanta; April 28-30, Los Angeles; April 30-May 2, Boston; May 7-9, New York; May 21-23, Raleigh, N.C.; May 28-30, Washington, D.C. Contact: Systems Technology Forum, 9000 Fern Park Drive, Burke, Va. 22015.

April 3-4, Tempe, Ariz. — **Software Quality Assurance: An Investment in Product Integrity.** Contact: Center for Professional Development, Arizona State University, Tempe, Ariz. 85287.

April 7-8, Boston — **Voice Mail and Messaging Systems.** Contact: Business Communications Review, 950 York Road, Hinsdale, Ill. 60521.

April 7-10, Washington, D.C. — **Federal Office Systems Conference.** Contact: FOSE '86, Suite 400, 2111 Eisenhower Ave., Alexandria, Va. 22314.

April 8-10, Washington, D.C. — **Federal Office Systems Expo.** Contact: FOSE '86, Suite 400, 2111 Eisenhower Ave., Alexandria, Va. 22314.

April 9-10, San Francisco — **Integrated Services Digital Networks.** Contact: Business Communications Review, 950 York Road, Hinsdale, Ill. 60521.

April 13-17, Boston — **Conference on Human Factors in Computing Systems.** Contact: ACM Conference Management, 11 W. 42nd St., New York, N.Y. 10036.

April 14-16, Los Angeles — **Telecommunications Management.** Contact: Business Communications Review, 950 York Road, Hinsdale, Ill. 60521.

April 28-30, New York — **Micro Communication Strategies.** Contact: Technology Transfer Institute, 741 Tenth St., Santa Monica, Calif. 90402.

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CIRCLE READER SERVICE NUMBER 107

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